# The Journal of THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

Vol. 22 DECEMBER, 1956 No. 4

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# THE JOURNAL OF THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE



**Editor:**
G. G. de PURY, B.Agr.Sc.,
C/o 226 Clarendon Street,
East Melbourne, C.2.

**Associate Editor:**
Mrs. E. A. DEXTER, B.Agr.Sc.,
C/o 226 Clarendon Street,
East Melbourne, C.2.

**Assistant Editor:**
P. F. BUTLER, M.Agr.Sc.,
C/o C.S.I.R.O., 314 Albert Street,
East Melbourne, C.2.

**Business Manager:**
J. A. ROBERTS, B.Agr.Sc.,
Executive Officer,
Australian Institute of Agricultural Science,
226 Clarendon Street,
East Melbourne, C.2.
Telephone: JA 4735.

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The Journal aims to publish material of interest to Agricultural Scientists, contributed by authors working in agricultural or related fields; authors need not be members of the Institute.

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Manuscripts should be double spaced and should be submitted in duplicate, as part of the delay in referring is then avoided.

For more detailed information concerning the preparation and lay-out of scientific papers, authors are referred to the C.S.I.R.O. publication "Guide to Authors" and to an article entitled "The Preparation and Editing of Technical Papers" by N. S. Noble, published in the Australian Library Journal, April, 1954. The policy laid down in these publications is also largely followed by this Journal.

In addition to the contributions described above, the Journal is pleased to publish "Letters", "News Items", "Talks" and "Personal Notes" which have been received from, or which are of interest to, members of the Institute.


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ARTICLES

# THE PLACE OF THE AGRICULTURAL SCIENTIST IN INDUSTRY

By A. N. JOHNSTON

The object of this review is to examine the present activities of trained agricultural scientists in industry; to assess their importance to our present agricultural economy and its future progress; to suggest the integration of the responsibilities of the agricultural scientist in industry with other fields of professional endeavour for the common good; to summarise from my own experience the specific qualities, both personal and by way of training, required of a graduate in industry. It is appropriate also to consider the responsibility of industry to agricultural research and its relation to the Institute itself.

## The Importance of Technological Progress to Agriculture

The accelerating application of science to agriculture either by the application of scientific principles or the direct use of applied research, is profoundly affecting many aspects of agricultural production and distribution, and consequently the economic welfare not only of the farmer, but all members of the community.

We have seen on the production side a completely new approach to crops and soil problems: the development of new, better and more adaptable varieties of crops, pastures and economic plants; improved agricultural chemicals and improved practices of controlling weeds, plant diseases, insect pests, and animal parasites; improved techniques of animal production, breeding and feeding; better machinery for crop and animal husbandry; improved techniques for more efficient use of our water and soil resources. Technological improvements in transportation, improved marketing techniques, conservation of surplus, and processing of foodstuffs have had dramatic effects on our agricultural economy.

The responsibility for the successful aplication of many of the results of scientific research, has been accepted by industry. Each phase of industry in the service of agriculture is backed by private enterprise with large capital investment, and trained service staff.

## The Significance of these Developments

Private industry serving agriculture is business, and naturally management looks for "big" business. Industry requires that the first duty of the manufacturer, the dealer, the retailer, and the adviser is to perform a necessary function and to get paid for it. How much is paid depends on how much the function is worth to the ultimate consumer. The products and services of industry are derived demands, requiring many agencies and functions between the manufacturer and the final users of his products.

The second immediate influence which we can partly attribute to technology and partly to global influences on our agricultural production (and our own economic

*A. N. JOHNSTON, B.Sc.Agr. is Manager of the Technical Research Division of Agricultural Services Pty. Ltd., Canterbury, N.S.W.* *This review was presented as the Presidential Address to the 21st Annual Meeting of the N.S.W. Branch of the Institute on February 24, 1956.*

survival in Australia) is the emphasis now placed on efficiency, both at industry and farmer levels. This interdependence of industry and agriculture, and the need for a farmer to conduct his operations on a firm business basis has led J. H. Davis, formerly Assistant Secretary of U.S.D.A., to suggest the term "Agribusiness"—as the sum total of all operations involved in the production and distribution of food and fibre (Anon. 1953). While one person on a farm feeds 18 of our citizens, Davis figures that "Agribusiness" accounts for 40 per cent. of the national work force, and 40 per cent. of the national product. He pointed out that 30 years ago agriculture produced 70-80 per cent. of its supplies for production and bought the rest from manufacturers, he noted today that it buys about half from industry.

Already our agriculture is a part of business and industry, but the concept is not yet absorbed into public thinking. Agriculture, as with industry, must look at its day to day techniques of operation and if it is to hold its place, must be run as an efficient business.

The third and very significant outcome of technological development is the demand for specialists in agricultural science. The increasing use of the agricultural specialist in Australian agriculture is naturally the history of this Institute. The contributions of agricultural research, the influence of trained agricultural scientists on policy and administration, the important contribution of the trained man in extension work have been very thoroughly reviewed for this Institute from time to time.

The demand for the agricultural graduate in private industry represents a more recent and very significant development. Industry at present generally lacks collectively the statistics which are available to indicate this trend. I quote for this reason from the records of membership of the Institute (Anon. 1955).

It will be observed that graduates employed in industry now comprise a significant proportion of Institute membership in Australia.

*Members of the Institute in non-Government Employment.*

| Year | Number | Per cent. of total |
|---|---|---|
| 1936 | 11 | 6 |
| 1940 | 18 | 4 |
| 1947 | 39 | 6 |
| 1953 | 109 | 10 |

Despite this absorption of trained men, industry is acutely in need of trained workers and it can be justly claimed that the shortage of trained agriculturalists is seriously affecting the capacity of industry to function with maximum effect.

### Recruitment of the Agricultural Graduate to Industry.

Both the demand likely to be made by private industry and the method of recruitment are necessarily important considerations which will require careful study by our educational administrators, and the training requirements must be of concern to our various Faculties of Agriculture. A graduate destined for industry will require specific training in certain subjects, and the Universities with the help of the Institute could profitably make a survey of these specific requirements.

Recruitment to industry is not yet stabilized, in most cases, management will require trained workers, who have gained wide experience, or persons with special qualifications for the positions being offered.

The extent of the problems growing out of the shortage of technically trained agricultural specialists even in the U.S.A. is emphasised by the following statement taken from a recent annual report of an agricultural college in that country:—

> "The chemical industry not only takes many of my best graduates but this year took four of my staff members".

Industry as an employer of professionally trained men is in direct competition for staff with Government and semi-Government institutions. Management in industry well recognises this competition, and in many cases, industry has much to offer able and ambitious men on the basis of improved salary, working conditions, and opportunity for advancement. Moreover, industry generally seeks men of experience, rather than graduates fresh from the University, and at present will leave post-graduate training in the hands of other employing agencies. However, I think that the organization and sympathy already exists to allow of the immediate absorption of the young graduate into industry, if he feels from his own personal desires and qualifications that he would like to embark on a commercial career.

Some of these aspects may be worth discussion by the Institute as affecting the welfare and professional opportunities of its members.

Certainly any healthy competition between employers for highly trained agricultural specialists must help our Institute to achieve some of the objects for which it was established.

On the long range view, industry must share some of the responsibility for training agriculturalists, and it could take the following positive steps to assist the profession to train the graduates it requires.

(1) Assistance at the undergraduate level—by provision of advice on course work; provision of scholarships during undergraduate training.

(2) Post graduate training—within industry's own organizations. It is noteworthy that in quite a few cases, particularly in the food processing industry, action is being taken along both lines.

(3) Full publicity of the opportunities for specialists in industry. We can naturally expect each industry to look after its own requirements, as evidenced by the recent Careers Exhibition conducted in Sydney. The Institute's part, I suggest, must be in keeping industry fully informed on the value of trained personnel, assessing the opportunities available in private industry and guarding professional standards.

### The Opportunities for the Agricultural Scientist in Industry

The trained agriculturalist selecting a career in private industry must appreciate he is entering a *commercial* career, with all the advantages and uncertainties of private enterprise.

At present the following industries offer opportunities for the agricultural graduate.

As a *private consultant*—The opportunities for consultants in agriculture are increasing. It is noted from a recent meeting of the Entomological Society of America that its President, George Decker, himself a Museum Entomologist, predicted that the entomologist of the future will be in private practice.

*Agricultural Chemical Industry*—Employment is offered in research, production, technical service and sales in many of the pesticide and fertilizer firms.

*Manufacturing Industries*—(Dairying, canning, milling, breweries, distilleries, meatworks) in management, production control and technical service.

*Agricultural and Pastoral Companies* in technical service, management, valuation work and commercial sales.

*Agricultural Machinery Industry* in research, production, technical service and sales.

*Banks, Insurance Companies, Financial Institutions*—in valuation, advisory work and land use survey.

*Radio and Journalism*—in rural press and radio, public relations and advertising work.

Industry thus offers a wide range of attractive employment to cover the interests of both the trained specialist, and the

graduate whose training in agricultural science has been based on the broad approach.

### The Importance of the Agricultural Chemical Industry to Australian Agriculture

I will restrict my comment on the place of industry in agriculture to that section of the Agricultural Chemical Industry concerned with the manufacture and supply of insecticides, fungicides and weedicides to the farmer, with which I am closely associated.

The magnitude of insect damage to agriculture is well known and insect pest control plays a vital part in agriculture and related fields such as transport and storage. In U.S.A., it is estimated that 22 per cent. of the wheat crop, 20 per cent. of fruit and 10 per cent. of animal products are destroyed each year by insects, with a total loss annually of $2,200 million (compared with $143 million annual loss by fire) and that $52 is returned for each dollar spent on insecticides (Murphy 1955).

In India, the total annual losses due to insects have been estimated at £150 million. A survey conducted in the United Kingdom in 1947 found that losses were equivalent to the produce from 1.1 million acres, out of a total of 18.5 million acres of arable land; the monetary value of crops lost was £78 million despite the spending of £10 million on insect pest control. Taking the average farm of 35 acres, and the average number of employed as 1.53 persons, the effect would be similar if 33,000 farms produced no crops and the labour of 51,000 workers was wasted.

Detailed statistics are not available for Australia. However, I have been able to discover some figures, which will indicate the economic importance of agricultural chemicals to Australian agriculture. Production targets, and sales of individual companies are necessarily confidential to their own organization, and it is therefore difficult to obtain an accurate estimate of the yearly production and consumption of agricultural chemicals.

The following estimates of manufacture may be of interest:—

*Value of Manufactured Items (Commonwealth Statistician).*

| Year | Insecticides Fungicides | Weedicides |
|---|---|---|
| 1950-51 | £2,266,000 | £534,000 |
| 1951-52 | £2,448,000 | £1,114,000 |

*Australian demand for raw materials (Anon. 1954).*

| Use | D.D.T. Tons | B.H.C. Tons | M.C.P.A. Gallons | 2,4-D Tons |
|---|---|---|---|---|
| Horticulural & agricultural sprays & dusts | 300 | 50 | 100,000 | 300 |
| Pastoral | 140 | 200 | | |
| Sugar cane | | 300 | | |
| Domestic | 10 | 30 | | |
| Total | 450 | 580 | 100,000 | 300 |

Some dissection of the application of agricultural chemicals to various phases of agriculture will indicate the influence of modern pesticides on cost of production and their importance in the production of high quality produce. Much of this information was collected at a recent Tariff Board Enquiry (Anon. 1954).

*Annual costs of pest and disease control for selected crops in Australia.*

*Tobacco*—Insect control programme.
Cost per acre .. .. .. .. £27/16/–

*Apples & Pears*—Insecticide and fungicide programme.
Cost per acre .. .. .. .. £35/13/3
Cost per bushel .. .. .. .. 2/10

*Citrus*—Spray programme.
Cost per acre .. .. .. .. £65/11/3
Cost per bushel .. .. .. .. 2/9

*Beans*—Spray and dusting programme for insect pests and fungus diseases.
Cost per acre .. .. .. .. £18/6/10
Production per acre .. .. £165/17/9
Cost per cent. of production 11%
Cost of production per lb. 4.09d.

*Cattle Tick*—Yearly Dipping Programme.

| | |
|---|---|
| Average cost of D.D.T. per beast per treatment .. .. | 8.7d. |
| Average cost of D.D.T. per beast per year .. .. .. | 78.3d. |

*Wheat*—Crop spraying for weed control.

The latest estimate indicates that over 2 million acres are now sprayed annually with 2,4-D or M.C.P.A.

| | |
|---|---|
| Average cost per acre of 8 ozs. of 2,4-D .. .. .. .. | 9/– |
| Application (labour, water, fuel, depreciation) .. .. | 8/6 |
| | 17/6 |

No review of this type would be complete without an analysis of the importance of the agricultural chemical used by the farmer in increasing the efficiency of his production. While it may be inconceivable that an orchardist would attempt to produce quality fruit without an adequate spray programme; the grazier neglect the regular use of suitable dips and blowfly specifics; or the cereal grower ignore the benefits of 2,4-D in weed control, both industry and the farmer lack detailed information on the all important influence of the chemical tool on the efficiency of production. The rural section of our economy will still be asked to contribute even more to our export trade to maintain and increase our overseas earnings. We know that this can only be achieved by producing higher quality at lower cost.

We could have no better analysis of the economics of the application of new techniques than that recently made by Campbell (1955) who states—"We must evaluate efficiency in terms of the value of the commodity produced and the costs of the various resources employed in its production".

The whole future of the assistance to agriculture from the chemical industry is closely bound to cost-price relationships —in other words the capacity of the farmer to pay. In certain fields, despite outstanding advantages, high costs of treatment are already limiting the use of certain chemicals.

While our present discussion is centred around the supply and use of chemicals as routine aids to farm production, the contribution of the agricultural chemical industry in times of national emergency is now well appreciated by the community. The recent successful application of B.H.C. and aldrin in combating the grasshopper menace is a good example of how quickly and efficiently industry can contribute in times of national needs. In Victoria alone £16,000,000 worth of crops and pasture were saved by an expenditure of £148,000 on chemicals and their application.

### Chemical Industry as a Business

While industry can provide a satisfying vocation for most agricultural graduates, either with specialist interests or with wide training, it would be wise to indicate that such employment in a particular industry does not allow for isolated effort, but demands very close collaboration with colleagues and constant consideration of the general welfare of the organization.

There are special features, some particularly unique to the chemical industry, which are basic in the organization of a successful company.

#### (*a*) *Agricultural chemicals are a relatively new business.*

The use of chemicals against pests is not new, it goes back to ancient history. However, discovery of the insecticidal powers of D.D.T. began a new era in agricultural chemicals. D.D.T. was so effective, and its discovery stimulated so much advance in the organic chemical attack against pests, that the growth of the industry has been tremendous since World War II. It has been estimated that 80-90 per cent. of industry business in 1955 was built around new chemicals not a pound of which was available in 1945.

The great promise of new openings produced a growth and development so rapid

that some of it has been random and haphazard. There is ample evidence already, despite the relatively junior position of the agricultural chemical business when compared with other industries, that the successful company will be one with good research, honest technical service, sound sales policy, realistic merchandising and general management policy.

(*b*) *The agricultural chemical industry is subject to rapid change.*

Agriculture and the industries associated with it are rapidly changing and they are changing at an ever increasing rate. This particularly applies to the pesticide industry.

The fact that these changes are the outcome of scientific research, means that the chemical industry must rely on the trained agricultural scientist to assist management to assess the importance of the new chemical and/or new technique to the future business of the company. With the rapid changes generating vigorous competition, a product or a technique can become obsolete or a strong business position quickly lost if research and technical services are weak. Company management needs to know the basic directions of movement, changes or needs which provide opportunities. Our whole modern society is based on the transmission of information. The success of the graduate in industry and the progress of his company largely depends on the speed and accuracy of that transmission.

(*c*) *Research is the life blood of the agricultural chemical industry.*

Being a child of research, the agricultural chemical industry must appreciate the importance of progress in agricultural research. It must consider both the need for basic and applied research and be prepared to accept considerable responsibility for both. During its rapid growth, the chemical industry has shown its capacity to conduct effective research and in certain notable cases in the U.K., U.S.A. and the Continent, the major advance in the discovery and development of a new pesticide has been entirely the responsibility of industry. I refer specifically to the origin of D.D.T., 2,4-D, B.H.C. and to the newer group of insecticides such as Diazinon and Malathion.

The cost of research and development already high is growing. The cost of developing a new insecticide is staggering, in the U.S.A. it is frequently more than $1,000,000. The costs of fruitless research, administrative overhead and capital for equipment, must be added to the cost of years of research and testing, residue and toxicological studies and production and sales development.

Naturally the cost of producing the chemical and the effectiveness of its application will determine the economic future of the product.

In Australia the capacity of the industry to sustain basic research within its own organization, and/or financially to support research institutions needs careful evaluation. Due to our dependence on overseas sources for raw materials, the lack of cheap power for manufacture and the highly competitive nature of the business, industry will not be able to give strong support to basic research. Yet, at the present stage of the application of chemicals to agriculture, further advances must await the results of such research. It is well recognized that the hundreds of chemicals available for screening and final evaluation are the products of the fertile mind of the organic chemist. Rule of thumb and empirical techniques of trial and error are still dominant philosophies but the drive for something better is becoming more intense.

There is an urgent need for fundamental studies in many directions. The first flush of our outstanding success with insecticides led us to believe that mastery of insects might be achieved by synthesizing such widely toxic poisons that, in one blow, we might eliminate all unwanted pests. Now we are slowly but surely being

disillusioned; we failed to reckon with the powers of adaptability which are inherent in all organisms. Kennedy (1953) has truly said "The pest controller today is wonderfully armed, but he still bears a remarkable resemblance to young David with his flock in the Bible, fending off wild beasts by hurling things at them".

In Australia, we have new races of cattle ticks, codlin moth and house flies resistant to D.D.T. and other chlorinated hydrocarbons and little knowledge of the nature of this resistance. Outbreaks of species hitherto of minor importance, such as red mite and light brown apple moth in orchard trees are now of major economic importance. Disruption of established measures of biological control is a further side effect of the use of modern insecticides, and this has already had serious consequences in horticulture, crop and pasture production.

The need to get information to the growers has kept many professional entomologists busy with field and laboratory testing of new insecticides. The accusation is made, with an element of truth, that many workers have spent their recent years testing overseas products with no opportunity to make contributions of lasting value to the profession.

Programmes of applied research must be vigorously pursued if an agricultural chemical company is to hold its place in this competitive business. This must mean the employment of biologists, entomologists, plant pathologists, agronomists, and chemists. This aspect of industry is rightly referred to as *product development*, to which I will refer in some detail later.

The attitude of management to research of this nature must be objective. Research costs are justified only on the promise that out of this work a certain number of compounds will develop which will have such highly desirable potentials for widespread introduction as to justify further and heavier expenditure of capital for production and sales effort. It is noteworthy that Campbell (1955) in the paper previously noted suggests this approach to government instrumentalities concerned with the distribution of research funds at the national level.

The relation of the agricultural chemical industry to research thus naturally prompts two important questions.

Firstly, should industry accept even more responsibility for proving new pesticides in the field, and secondly should industry provide more liberal support to Universities, Government Departments and C.S.I.R.O., similar to the support given in its fellowship programme to basic chemistry and physics?

(*d*) *The agricultural chemical industry must make profits.*

The selling price of a chemical is the balance between the manufacturers' cost of development, production and marketing and the growers' ability to pay.

Marketing is part and parcel of the modern productive machine, and in industry it is the end which gives purpose to all that has gone before.

Specialization in the marketing of agricultural chemicals requires the manufacturer, formulator, distributor and retailer, all performing particular functions and all entitled to recover their costs and enjoy a reasonable profit on the capital and effort each has invested.

Whatever his particular vocation in industry the trained agricultural scientist must be well aware of the importance of the profit motive and appreciate that he can often make a significant contribution to successful selling.

(*e*) *The success of the agricultural chemical business depends on accurately conducted market research.*

The pesticide industry is confronted with three major factors which contrast it sharply with other industries. They are—

(i) The short season use.
(ii) The large variation in annual use.
(iii) Rapid obsolescence of chemicals because of new developments.

These present a real problem to management and their effects, if wrongly evaluated, can quickly mean the difference between profit and loss.

The proper marketing of chemicals for short season use, such as is characteristic of the present market for weedicides, requires a careful survey of requirements in point of time and location. 80 per cent. of this large market must be satisfied within the months of July and August each year. The seasonal variation of demand due to variation of infestations of insects and fungus diseases shows how the agricultural chemical industry is closely concerned with ecological factors of weather, soil, etc.

The agricultural scientist can effect an important contribution to the establishment of stable and profitable business by advising management on the total volume of business, the seasonal production programmes, and on the very important trade problem of bulk stocks on a regional and seasonal basis. Failure to employ such a research or market service has already led to disastrous results to some companies and serious repercussions in the trade.

It has been the experience of the pesticide industry that price cutting does not influence the total volume of business, and it is very clear that the major factors are the severity of the attack, and the value of the crops or stock to be attacked. When the farmer has made up his mind to protect his investment, then he usually wants your product quickly.

The agricultural graduate can assist greatly in conducting market survey by providing statistics which are lamentably absent at the present time.

Forecasting without enough data invariably leads to over-estimating the size of the market and usually under-estimates the manufacturing and selling costs. This means over-production and low profit margin.

*(f) The agricultural chemical industry must be prepared to give technical service with its product.*

The provision of a technical service to the client is a necessary corollary to new product development, and in practice it is a very strong force supporting the commercial efforts of the company. Any new pest control agent must be carefully and closely serviced to be sure that it is used in the right amount, in the right way, and with safety to meet all approved needs. It is only in this way that the potentialities of a useful product can be fully realised, and its place in our agricultural economy established. The need for technical service to pesticides, conducted by trained agricultural graduates, arises also from the important fact that in many cases, recommendations for use need to be translated in terms of area and local differences.

The graduate employed in technical service is the extension officer of the industry engaged in a very vigorous educational programme. Apart from his job as an extension officer to members of his company's selling staff, his duties are closely concerned with the way of life of his client. The technical service officer must realise that the farmer wants essentials only and that he will be accepted by the farmer if he shows understanding of the farmer's problems, position and progress. By maintaining current high standards of research prior to the introduction of new products a company can create an atmosphere of confidence and greatly assist the efforts of the technical service officer.

The continued successful use of new chemicals particularly the more recently developed insecticides, herbicides and now defoliants indicates the value of such service not only in promoting the welfare of industry, but in introducing farmers to new chemicals, new techniques, and almost a new vocabulary. We have seen farmers learn how to handle numerous complex chemicals, when they only used to know the word "POISON".

(*g*) *The agricultural chemical industry requires all the support of public relations.*

The sale of agricultural chemicals, the establishment of a particular brand, the prestige of the company require all the techniques used in public relations. Advertising must ensure that the products are well known and well represented. Specifications for use must be dependable and realistic.

It is well realised in the industry that education is the only defence against restrictive legislation. The number of ways in which pesticides can be mis-used is great despite careful labelling and instructions for use. Liability problems can be assessed by the trained graduate and his influence can be brought to bear on the public relations programme of the company.

(*h*) *The agricultural chemical industry requires, and seeks the close co-operation of Government and semi-Government institutions.*

The progress of the agricultural chemical industry has been associated with close liaison with University, Government and semi-Government Research Institutions. Industry has willingly supplied samples for evaluation, together with available technical data to assist.

It can therefore be anticipated by the agricultural graduate that he will, in whatever capacity he is employed, be in close touch with other workers in his field. This will allow frequent inter-change of ideas, and assist to build up goodwill and service with these institutions.

(*i*) *The agricultural chemical company must have strong overseas affiliations.*

With an industry so dependent on overseas developments and information, it is usual for the Australian company to develop close commercial and technical associations with overseas principals. Overseas chemical companies maintain their own research organizations, or liberally contribute to research institutes. Graduates can therefore expect to keep in regular contact with overseas developments, and often the transmission of information is such that industry is acquainted with developments before they appear in recognised scientific journals.

**Positions Available in the Organization of an Agricultural Chemical Company**

Business is conducted largely on a personal basis. This naturally requires a capacity to deal directly with your client or with colleagues, singly or in conference. Secondly, industry decisions are generally made quickly, so that the trained worker must anticipate being required to give advice quickly and concisely. Thirdly, and this aspect may be disturbing to the trained research man working in industry, the trained worker is expected to be carrying along many projects at the one time. It is seldom possible to start one project and carry it on to completion before embarking on a fresh venture.

The *research and development* section of industry relies completely on the specialist and gives greatest scope for the trained agricultural scientist. As already emphasized, new technological advances released from research must be evaluated and developed. The capacity of a firm to support an expensive programme to bring out new products varies with its resources and companies employing a research division must have the staying power to support research through the long process of laboratory, field, toxicological and market testing.

The development of a typical new pest control agent involves co-ordinated effort of biologists, entomologists, plant pathologists, agronomists, chemists, and toxicologists.

A glance at the organization of a technical development division may underline the opportunities available to the agricultural scientist.

At present, most manufacturers receive promising agricultural chemicals from overseas principals who usually pass on the chemicals with some preliminary ad-

vice on their properties. Preliminary screening before wide field testing to indicate its particular biological activity is carried out in the biological laboratory. This stage of development allows for the employment of the entomologist, the plant pathologist, the parasitologist or the plant physiologist.

The formulation chemist is then called on to prepare the agent in a usable form to meet current application equipment. The agricultural chemist is particularly suitable for this appointment as this work must be closely associated with his colleagues working in the field. Each type of formulation presents its own problems, e.g., an emulsifiable concentrate requires knowledge of the performance and interrelations of the active chemical, its solvent and emulsifier. Compatibilities of the product with other pesticides must be established, both in relation to their chemical interaction, and their effect on the host plant or animal.

Apart from working closely with the entomologist or similar workers, the formulation chemist must keep in close contact with the production manager, to determine that the manufacture of the new chemical and its formulation will be planned along sound economic lines within the framework of the existing factory equipment and space.

Field testing, and evaluation under a wide range of conditions of the new pesticides is naturally a job for the specialist, providing employment for the entomologist, plant pathologist, agronomist or veterinarian depending on the proposed use of the chemical. Officers responsible for this work in industry, apart from organising their own programme, must quickly arrange for collaborative work with Government and semi-Government research organizations. This work is designed to test the capacity of the pesticide under the widest range of conditions. The specific performance of the insecticide; the optimum rate of use; its effect on crops or animals; the importance of residues on food crops or animals or soil; methods of application; likely costs of use and economic return from use; are a few of the important considerations which will require investigation. The programme of field testing to determine the real merit of the pesticide is a long one, and with a programme of extensive field testing, one can predict with a great degree of accuracy what to expect from the chemical before it is marketed.

Industry must accept the responsibility for determining the safety factor in relation to the manufacture, handling, and use of its products. Investigations of this type require trained toxicologists, a field which could be of interest to the trained biologist. The studies are basic, requiring large laboratory facilities, animal houses and specially trained staff. No such facilities are provided by Australian companies to date, and all toxicological evidence used is obtained from overseas.

*The summary of the work of research and development is the product label, which should describe in brief the nature of the chemical, directions for use, specific recommendations, hazards (if any), package size, conditions of sale, and the manufacturer's place of business. The label therefore is an important technical, commercial and legal document.*

As noted earlier, the chemical industry must retain highly trained agricultural or veterinary graduates for its technical service. The class of chemical business naturally determines the type of trained personnel; the weedicide business requires an agronomist, the insecticide business the entomologist and so on.

Specialist training can be very profitably employed in sales promotion through market surveys and research. The graduates entering sales, looking for careers in the commercial organization of the company, must be aware of the need to learn the art of salesmanship, and also to realise that their advantages of a scientific training amongst their less trained

colleagues may disappear very quickly. There are many graduates in industry who have shown outstanding capacity in the sales field, and in some cases, have progressed to top management through their success in the sales organization of the company.

*It is clear that the agricultural chemical industry must become one of the most scientifically managed of our industries, for care and control must be exercised from the concept of a research idea through to the final application of the marketed product.*

### Industry and the Institute

To summarise under this heading:—

(1) Industry is assisting the Institute in one of its main objectives by adapting the technological advances available from research to further agricultural production.

(2) Industry is now providing a significant membership to this Institute.

(3) The training and recruitment of agricultural scientists to industry and the opportunities for specialist employment in industry are matters for the consideration of the Institute.

(4) Industry is already taking significant steps in the educational and extension field to stress the importance of the agricultural scientist, and the services available through him to the farmer. The Institute might well continue to seek the assistance of industry in implementing its "plan ahead".

(5) The contribution of the agricultural chemical industry to research, either directly or indirectly, and its capacity further to assist our agricultural research programme might also engage the attention of the Institute.

(6) The unique character of the agricultural chemical industry as outlined may suggest to the Institute, that other industries may be reviewed for the information of members.

(7) The Institute must ensure all employment of agricultural specialists in industry is consistent with professional standards.

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## APPOINTMENTS AVAILABLE *see also pages 254, viii and ix*

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Department of Agriculture.

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# THE PRACTICE OF SUB-SOILING — A BRIEF REVIEW

By C. B. WELLS

**Summary**

The general field of subsoiling is considered from three aspects, namely, subsoiling, subsoil placement of fertilisers, and agricultural systems in which subsoiling is included (e.g. the Mal'tsev system).

Subsoiling is expensive and is not warranted unless the soil profile contains a hard pan which can be burst open, and which is limiting to plant growth for any direct or secondary reason.

Subsoil placement of fertilisers has not yet been shown to be any material improvement upon plough-depth or seed depth placement.

## Introduction

Subsoiling is a system of deep tillage by which the subsoil is disturbed and loosened but not turned over nor brought to the surface. The practice appears to have arisen in America where the first subsoiler is claimed to have been made by Gideon Davis of Georgetown D.C. in 1845 (Bennett 1939). Its use, in the form of a plough-subsoiler, later spread to England and then to France and her colonies (Mandelli in Hopfen 1938). More widespread use has only come in recent years—for instance, it was as recently as the mid 1930's that a plough-subsoiler was used to any extent in Italy (Mandelli in Hopfen 1938).

There is much argument both for and against the worth of subsoiling. Part of this arises through misunderstanding both of the practices themselves and of the particular purposes of each. If the present-day scope of subsoiling is regarded as divided into three parts, much of the misunderstanding can be avoided. These three are:—

(a) subsoiling.
(b) subsoil placement of fertilisers.
(c) agricultural systems using subsoiling e.g. the Mal'tsev system.

## Subsoiling

It has been claimed for subsoiling that it helps to increase the permeability of a soil profile, that it is a means of overcoming drought by increasing the water-holding capacity of the soil, that it allows plant roots to explore and derive their living from a greater volume of soil and, as a result of these, it leads to increased yields (Sanders 1947; Watson and More 1949; Jouis and Dufort 1952; Shcherbinin 1952). All these have been claimed, but they have, at the same time, been equally loudly renounced (Chilcott and Cole 1918; Smith 1925; Woodruff and Smith 1947; Martinez and Lugo-Lopez 1952b). This arises because there are certain soil conditions under which subsoiling is found to have these advantages and others in which it does not.

The value of breaking up a subsoil in an attempt to improve permeability depends upon the nature of the particular subsoil concerned. If it is porous already the yield of crops is, in nearly all cases, reduced (Raney, Edminster and Allaway 1955) and where there is a gain it is never sufficient to pay for the cost of subsoiling (Winters and Simonson 1951; Millar and Weidemann 1947 quoting Lyon 1898). If it is a heavy clay, subsoiling is of little benefit to permeability or aeration because the clay is rarely dry enough for the necessary shattering to occur (Diebold 1954) and it would all run together again at the first good wetting anyway (Sanders 1947; Smith 1925). If, however, there is a hardpan within the profile, subsoiling

*C. B. WELLS, B.Ag. Sc. is a Soil Surveyor with the Division of Soils, C.S.I.R.O., Waite Institute, Adelaide.*

can be of considerable benefit in that by shattering the hardpan it leads to improved conditions for water movement and plant growth (Ricks 1915; Kerr and Bell 1939; Martinez and Lugo-Lopez 1952a 1953). This hardpan may take very many years to re-form, if it does at all (Winters and Simonson 1951), so that it is well worth while to break it up. On the other hand subsoiling can hardly be an economical way to break up a compacted plough sole. This is better done by deliberately ploughing at slightly different depths each year, or else by chisel ploughing (Diebold 1954).

As a means of overcoming drought, American workers have found subsoiling to be not only useless, but even detrimental. They consider that in many cases subsoiling, instead of overcoming the effects of drought, actually intensifies them (Chilcott and Cole 1918). In an experiment where beneficial results were reported, the value of the increased yield was only 1/6th of the cost of subsoiling (Chilcott and Cole 1918 quoting Mosier and Gustafson 1915). In cases where the season has been below average in production, the effect of subsoiling has been to further decrease yields, despite various additional soil treatments on the different plots (Chilcott and Cole 1918).

The productive capacity of soils not having a hard pan or a clay pan does not appear to be improved by subsoiling. By far the greater number of reported experiments in America, England, Canada, Germany, Italy, Puerto Rico and Australia have borne this out (Chilcott and Cole 1918; Smith 1925; Woodruff and Smith 1947; Jones and Rogers 1949; Hopfen 1938; Martinez and Lugo-Lopez 1952b; Burvill 1950). This represents a very wide range of soils and climate. On the other hand it is reported that many New Jersey soils (mostly grey-brown podzolics) profit from subsoiling (Millar and Weidemann 1947 quoting Nissley 1940) as also do some Swedish ones (Tortensson and Enge 1943).

In general, then, sufficient increases in yield and productivity to cover the heavy cost of subsoiling are not forthcoming for most crops in most soils of the world. Subsoiling by itself is only warranted in those soils where there is some definite, appreciable hardpan or compacted layer to be broken through.

### Subsoil Placement of Fertilizers

A somewhat different aspect is presented when fertilisers are incorporated within the subsoil (Woodruff and Smith 1947; Smith 1951). The object in this is to induce plant roots to spread further and in greater numbers throughout the soil and so to draw their mineral and water requirements from a larger volume of soil. This was one of the claims made for subsoiling itself, but it has been shown by experiment that water-uptake, for instance, was not materially altered in the zone below that in which the subsoil fertiliser had been placed (Gliemeroth 1953).

The subsoil placement of fertilisers is a recent development (Jones and Rogers 1949) but it has been shown already that significantly and economically better yields are often obtained if half the total amount of fertiliser to be applied is put into the subsoil and half into the topsoil (Lugo-Lopez and Martinez 1952). By contrast, it was found that various types of subsoil cultivation alone had no greater effect on yields of sugar cane than did ploughing of the surface soil (Martinez and Lugo-Lopez 1952b). On the other hand there are also experimental results to suggest that normal plough-depth placement is often as effective as deep placement (Raney *et al.* 1955; Jones and Rogers 1949) with the result that in recent years the practice of subsoil placement of fertilisers has been losing favour in many parts of the United States (Winters and Simonson 1951). It may be that the favourable results merely reflected a better distribution of the fertiliser through these soils. Again, as with subsoiling,

it appears that too much has been expected of the operation itself without giving sufficient thought to the subsoil concerned, especially as to whether it is in fact a low mineral-nutrient content and/or permeability of the subsoil that is limiting to plant growth.

A further and more recent refinement has been reported in which a machine first shatters the subsoil and then thoroughly and evenly permeates it with fertiliser by using compressed-air jets (Wojta *et al.* 1955). This is claimed to induce even better root distribution, water usage, and yield. It is too early yet to decide the soils and circumstances in which this method may be worth while.

### An Agricultural System Involving Subsoiling

Reports from Russia of a system of farming developed for the Trans-Ural region and the Ukraine, and called the Mal'tsev system, point to a different purpose in subsoiling; a purpose quite removed from any pan-breaking. In this case attention is directed primarily towards the organic fraction of the soil rather than to the inorganic, as before.

Mal'tsev's system of cultivation (Mal'tsev 1954; Genkel 1955) was developed as a result of a conviction that, given suitable conditions, *all* plants are able to improve soil fertility, and was an attempt to build up soil fertility in areas where it is necessary to grow annual crops because perennials do not thrive. He reasoned that fertility is not raised where annuals are grown, because the root residues are decomposed oxidatively and therefore no humus is formed. On the other hand the root residues of perennials are decomposed in an environment of restricted oxygen supply, with humus formation as a result. His system is designed to provide, at least occasionally, semi-aerobic conditions for the decomposing root residues of annual crops.

To do this he broke away from the existing methods of cultivation not only by reducing the frequency of cultivations but also by designing a special plough, virtually a subsoiling plough, to change the type of ploughing commonly used. Thus the rotation he recommends is:—

(1) Fallow.
(2) Spring wheat with deep ploughing.
(3) *Oats with cultivation.
(4) Annual grass for hay or seed, with cultivation.
(5) Spring wheat with cultivation.

(*This may be omitted if only a 4-course rotation is wanted.)

The general plan of cultivation is:— (a) to subsoil plough to about two feet depth once in every 4 or 5-year rotation, except in the first one when there are two deep ploughings, one in summer and one in autumn and at right angles to each other; (b) to harrow to about 3 inches depth after rain, to conserve soil moisture; and (c) to disc cultivate to about 3 inches depth as often as is necessary to kill annual weeds, the perennials being killed by the subsoil ploughing.

In addition to raising soil fertility it is claimed for this system that it does effectively combat weeds to the point of eradication, that, through the subsoil ploughing, it improves the supply of food and moisture to the plant and that the reduced number of ploughings gives a considerable saving in fuel costs. The reaction from the plant (spring wheat) is claimed to be an increase in the number, by weight, of young roots in the 40-50 cm layer in addition to an increase in their total and active absorbing surface when compared with normal 22 cm ploughing. The result is an increased resistance by the plant to heat and drought, and an increase in yield.

Reports from various areas with their differing climate, soils, etc., and for various crops, generally support the Mal'tsev system as being favourable to increased yields (e.g. Rabochev 1955, cotton in Turkmenia; Eremenko and Shchupakovskii 1955, cotton and rice and non-irrigated grain crops in Uzbekistan;

Gorshenin 1955, for Siberian soils) but some doubt is expressed about its suitability to virgin soils (Yarkov, Gromyko, Kutznetsov *et al.* 1955) and to its rigid application to all soils in all districts, for instance to podzols in Siberia (Gorshenin 1955). This is only confirmation of Mal'tsev's insistence that the system would probably have to be modified, especially as regards depth of ploughing, in areas where soil and climate differed from those where he did his work, that is, Chernozem and Chestnut soils and soils with a layer of low fertility as in sod-podzolized soils (Mal'tsev 1954).

Mal'tsev therefore uses subsoiling for an entirely different purpose to those described in the previous sections. For this reason, again, experimental results from the two uses of the same cultural operation of subsoiling cannot safely be compared.

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## BOOK REVIEWS

### MILK AND BUTTERFAT RECORDING

By E. D. ASHTON

(*Commonwealth Bureau of Dairy Science and Technology, Technical Communication No.* 3. (224 *pages including* 88 *tables.*) *Obtainable from the C.A.B. Liaison Officer at* 314 *Albert Street, East Melbourne, C.2, Victoria. Price* 37/6.)

"Not for 21 years has a book been published surveying the systems used in different countries for recording the production of milk and butterfat of the world's dairy cows. During this period great changes and developments have occurred. The author is the Head of the Bureau of Records at the Milk Marketing Board in England and therefore in a unique position to survey, compare and contrast the different methods used not only in Britain but also in other countries.

The book is divided into two main parts, the first dealing with the historical development of milk recording and butterfat testing, the organization of societies and associations, their financing and the use of records by various interested bodies such as herd book societies, artificial insemination centres and research workers. The second and larger part gives in considerable detail the growth and organization of recording societies in a large number of countries. Throughout the book there are some 88 tables giving details of numbers of cows, yields, butterfat tests, etc., as well as a number of appendices. Photographs illustrate the technique of milk recording and butterfat testing under widely differing conditions from Iceland to Australia.

The book will be of interest not only to those intimately concerned with the work of recording societies but also to progressive dairy farmers, herd book societies, government officials, agricultural research workers and the world's dairy industry generally."

# THE FACULTY OF RURAL SCIENCE OF THE UNIVERSITY OF NEW ENGLAND

By G. L. McCLYMONT

Graduates in veterinary and agricultural science have made incalculable contributions to efficiency of livestock production; even though much remains to be done, and always will, as regards research and extension of knowledge in the fields covered by these two types of training. However the successes of such graduates in solving many problems of animal health, soil fertility and pasture establishment, has resulted in a situation where some of the major factors limiting efficiency of livestock production are not those usually studied in depth in either course of training. These factors are the nutrition, breeding and management of the livestock, and appreciation and management of the soil-pasture-livestock complex as a biological and economic whole. For in veterinary science the central pivot of training is the cause, prevention and cure for livestock disease, with considerably lesser emphasis on nutrition, breeding, and management, and orienting reference only to plant and soil science, and agriculture as a whole. (It is understood that some fifteen per cent. of the course is devoted to "animal husbandry" subjects at Sydney.) And in agricultural science the emphasis is on the soil and the plant, in all their aspects, with largely only orientating reference to livestock.

Recent years have seen enormous advances in knowledge in the pure soil and plant fields, in the cause, prevention and cure of animal disease, and in the fields of knowledge more directly associated with livestock production, namely nutrition, breeding and management of the livestock, and soil-pasture livestock relations. These advances in knowledge have been so great that it is no longer possible to cover all the fields as thoroughly as their economic importance justifies in the two existing courses. The deficiency of what has been termed "animal husbandry" training in courses of veterinary and agricultural science has of course been recognized in recent years, and corrective measures have been taken, such as creation of a readership in Animal Physiology in the Faculty of Agriculture in Melbourne, a chair in Animal Husbandry in the Faculty of Veterinary Science in Brisbane, and a chair in Animal Husbandry jointly in the Faculties of Veterinary and Agricultural Science in Sydney. However such extra emphasis on animal husbandry in courses of agricultural and veterinary science, though very overdue, does not meet the need for a course specifically orientated about the fields of knowledge involved in livestock production, with opportunity for specialization again within that field, such as, in sheep, beef cattle, dairy cattle or poultry science, or livestock nutrition or breeding. Specialization in animal husbandry in existing courses as is now planned in the Faculty of Agriculture at Sydney, or post-graduate training, although both playing valuable roles, cannot fully meet the need.

It was to meet this need for a course to complement existing courses, felt not only by many graduates (*vide* correspondence columns of the Aust. Vet. J. 1952-53) but also by many leading primary producers, some on the Council of the University, that the University of New England established the Faculty of Rural Science. Some details of the course are

*G. L. McCLYMONT, B.V.Sc., Ph.D., is Professor of Rural Science at the University of New England, Armidale, N.S.W.*

given below. The title "Rural Science" was chosen in preference to "Animal Husbandry". The latter term has rather specific connotation as a field concerned with the care of animals whereas soil-pasture-livestock relations was envisaged as a major aspect of the new course. "Rural Science" provided a term with broad implication, but till then no specific connotation. Many of the courses to be taught will have their counterpart in agricultural and veterinary courses. However they will differ in that both lectures and practical work will be biassed towards those aspects of soils, plants and animals which are of prime positive importance in livestock production. For example, in animal physiology lectures and practical work, growth, wool and egg production, and lactation, will receive far more detailed treatment than those fields more of interest from the point of view of veterinary medicine and surgery such as neurophysiology. Similarly, in plant physiology and agronomy, pasture and fodder species and their reactions to environment and grazing will receive far greater attention than aspects of the subjects more cogent to the specialized plant industries. Plant breeding will, for example, receive only orientating reference, sufficient to indicate the role of the specialized knowledge of the agricultural scientist in the field. Animal disease will be treated largely from the point of view of control of the major economic diseases with the role of the special knowledge of the veterinarian made evident.

The course will be a four-year one. In England some agriculture courses are only three years, but it is perhaps significant that Edinburgh has recently reverted to four. Traineeships have been established in the Faculty by the New South Wales and South Australian Departments of Agriculture and the New South Wales Department of Education.

A number of factors influenced the decision to establish the Faculty of Rural Science at the University of New England.

The situation of the University is unique in Australia, in the centre of an intensive pastoral area and with easy access to a wide variety of livestock industries, including dairying, poultry, farming and pastoral.

The University is closely associated with the C.S.I.R.O. Regional Pastoral Laboratory, the laboratories being situated in the University grounds, and the 4,500 acre field station, "Chiswick", running 6,000 sheep, and beef cattle, within a few miles. This association with the University has been cemented by an agreement under which work of the Laboratory is directed by a Research Committee representing the C.S.I.R.O. and the University, with the writer as chairman, and all facilities of the C.S.I.R.O. and the Faculty of Rural Science are mutually available to personnel of both organisations. All C.S.I.R.O. graduate officers have been admitted as members of the University and are available for special lectures in their fields. The senior officer of the C.S.I.R.O. Division of Plant Industry, Mr. R. Roe, B.Sc. (Agric.), Principal Research Officer who is Deputy Chairman of the Research Committee, has also been made an Honorary Associate Professor of the University and is a member of the Faculty.

The University was also able to provide for the Faculty a unique site allowing an ideal intimacy of contact with the heart of the University, the residential colleges, and intensive and extensive facilities for teaching and research with pastures and livestock, including a generous gift by the now Deputy Chancellor, Mr. P. A. Wright, of a 300 acre farm adjoining the University grounds.

The graduates of the course will have appropriate training for several fields including livestock breeding and production, research and extension in the livestock industries, positions in pastoral and stock feed manufacturing firms, and teaching.

The education of persons who will return to the land is a major goal of the faculty. For such persons will be able to do much, by example, precept, and practice, to close the present large and growing gap between knowledge and its application. For this reason we aim to attract to the course the sons and daughters of those on the land, as with present economic considerations these are the only graduates who in quantity are likely to return to the land. The proportion of the seventeen students enrolled this year who intend to return to the land eventually, indicates that this aim will be achieved.

**Curriculum of the Faculty of Rural Science**

*1st Year*

Botany I
Zoology I
Chemistry I
Elementary Physics
Introductory Rural Science (including Agricultural Geography and History of Agriculture

*2nd Year*

Livestock Anatomy
Livestock Physiology (General)
Biochemistry
Agricultural Botany
Microbiology
Livestock Management I
Biostatistics

*3rd Year*

Livestock Physiology (Special)
Agricultural Geology and Soil Science
Livestock Nutrition
Genetics
Agronomy
Agricultural Machinery
Livestock Pathology and Parasitology

*4th Year*

Agricultural Economics and Farm Management
Livestock Management II
Livestock Products Technology
Livestock Breeding
Pasture Science
Livestock Health

Minor courses on:—

Agricultural Institutions and Pastoral Law
Extension Methods
Principles of Research
Wild Life

Some degree of specialisation on a subject or industry basis may be allowed in the final year.

(*Received for publication, July* 20, 1956).


## APPOINTMENTS AVAILABLE *See also pages 245, viii and ix.*

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# CONSUMER ACCEPTANCE OF DAIRY PRODUCTS — W.A. EXPERIENCE WITH A PILOT SURVEY

By E. MUNCH-PETERSEN

Asking is the only rational method of determining how acceptable are dairy products and the reasons for their acceptance. However, to frame questions that will result in meaningful answers is no easy task. And consumer habits in one country may be so different from those of another that questions asked in one such country are completely meaningless in another. Even granting that rational questions allowing only unqualified meaningful answers can be set, there still remains the question: How many people shall be asked, and from which classes, districts or income-groups, to give results that are generally applicable?

Most progressive countries have solved, at least in part, most if not all of these problems. Hence, it was thought that W.A. could do likewise. But there was a difference: In W.A. nearly all organizations concerned with dairying united to tackle the task. Elsewhere, it has been the work of one or another fraction of the industry, or even of an independent body, such as a Research Institute.

### Composition of the Committee

The Farmers' Union of W.A., the Milk Treatment Plant Operators' Association, the Milk Retailers' Association, the Butter and Cheese Manufacturers' Association, the Australian Institute of Dairy Factory Managers and Secretaries (W.A. Division) and the Australian Society of Dairy Technology agreed to form a Sub-Committee to do the work. It was called the "W.A. Dairy Promotion Committee."

The Department of Agriculture gave valuable advice and moral support.

This "Promotion Committee" consisted of Mr. E. Munch-Petersen (Convenor), Mr. C. Thompson, Mr. F. Oates, Mr. N. Marsh and Mr. A. Rosher.

The questionnaires were drawn up by E. Munch-Petersen and the final form agreed to by the Committee; the sheets were duplicated by the Farmers' Union, distributed and collected by the milk roundsmen and analysed by E. Munch-Petersen. As a result, actual expenditure was kept at a minimum.

### Background Information

Before presenting the questions and answers, a thumbnail sketch of the W.A. dairying industry will be attempted. Dairy-farming is limited largely to the south-west area; a small proportion is done on irrigated land. In most districts the soil is deficient in phosphorus, probably in potassium, and usually in one or more trace elements. The dairy farms originally established on part-cleared land were under-capitalised; there is still considerable scope for pasture improvement, fodder conservation, herd improvement and—especially—artificial insemination. Of cattle diseases, tuberculosis, at least in "whole-milk" areas, has been reduced to about 1%, vaccination against brucellosis is common and the incidence of mastitis is said to be low. Hygiene in the 3,000 or so dairy farms is probably similar to that found in most Australian

*E. MUNCH-PETERSEN. M.Sc., B.A., M.I.F., C.E., is Senior Research Officer with C.S.I.R.O. Division of Animal Health, stationed at the Institute of Agriculture, University of Western Australia, Nedlands, W.A. and is President of the Western Australian Division of the Australian Society of Dairy Technology.*

dairying districts. Milking is mostly by machine, farm cooling of milk or cream is not widespread, although summer temperatures often range around 90°F for many days.

The climate is typically Mediterranean —with rainy winters and dry, hot summers. The average rainfall is adequate, but somewhat irregularly distributed. Hence, milk production is highly seasonal.

Pure-bred herds are not common and the average lactation period is 6.9 months. The annual milk production has been around 50 million gallons, of which about a quarter to a fifth is consumed as whole-milk.

There are five treatment plants in the city of Perth, one, recently established, in Brunswick Junction and serving as a centre for provision of pasteurized milk to country towns and districts. All are modern and efficient. Butter and cheese are made in 15 factories, but the amount of each is insufficient to meet local demands. Roads are excellent and transport well organized. Milk for Perth is conveyed in huge road tankers. Supervision of butter and cheese factories and farms supplying them rests with the Department of Agriculture, of milk treatment plants, country milk depots and farms supplying these, as well as milk rounds, with the Milk Board.

Well over 90% of milk under Milk Board control is pasteurized and sold in bottles; the average consumption is 0.66 pints per person per day; of butter about 30 lb per annum, and of cheese about 6 lb per annum. About one-half of all cheese sold is wrapped, rindless, the rest is mostly Australian cheddar and very little of imported continental varieties.

Of about 600,000 people in W.A. over one-half live in Perth which is more than 2,000 miles removed from its nearest neighbour of comparable or greater size.

Schapper (1953) gives further information.

### Sampling technique

A total of 1,200 questionnaires was sent out by the Promotion Committee for distribution. The questions regarding milk, butter and cheese, respectively, were printed on separate sheets. Only one sheet was left for each household.

In Perth four different suburbs were selected so as to represent, as far as possible, a cross section of four income groups; namely:—

(1) basic wage.

(2) just above basic wage.

(3) well above basic wage.

(4) high income.

The demarcation of these groups is fairly well established for a considerable portion of the area of Perth.

The same technique was used in Bunbury, where, however, the demarcation between income groups is less sharp. The local dairy products factory is quite an important industry, and its presence may well have influenced the answers given by some of the local residents.

It is much to be regretted that no questionnaires were distributed in the Goldfields' towns, where supplies and storage of dairy products are particularly difficult.

The returns, expressed as a percentage of the number of questionnaires known to have been distributed, amounted to 51 for milk, 49 for butter, and 46 for cheese.

### Results

#### *Milk*

*Questions*:

(1) Which kind of milk to you prefer:—

  (a) The bottled milk you now get?

  (b) Condensed milk?

  (c) Powdered whole milk?

  (d) Powdered skim milk?

(2) Would you use more milk if it were cheaper?

(3) What, to you, is the attraction of milk:—
  (a) Taste?
  (b) Its nutritive value?
  (c) Its flavour?
  (d) If you have any other reason please state it.

(4) What do you mainly use milk for:—
  (a) For children?
  (b) For cooking?
  (c) As a beverage in coffee, tea or iced?
  (d) Any other reason?

(5) Have you any comments on your present supplies?

*Replies*:

The total number was 153.

(1) 141 use bottled milk and 12 prefer bulk milk.
  23 use condensed milk.
  24 use powdered whole milk.
  1 uses skim milk.

Twice as many housewives in Bunbury as in Perth used powdered whole and condensed milk.

(2) 112 would use more milk (i.e. bottled, pasteurized) if it were cheaper, 4 might, 28 would not and 9 did not reply. One and a half times as many Bunbury as Perth housewives would not buy more milk.

(3) More than 94% found the nutritive value of milk its greatest attraction; for 36% the taste was the attraction; for 30% the flavour; and to a small number other attributes.

(4) Milk is used as a beverage in tea and coffee by 125 (81% of replies); for cooking by 114 (74%); for children by 96 (63%); for other purposes by 21. There was no difference between Perth and Bunbury replies.

(5) Comments were given in 79 replies—65 (82%) expressed satisfaction, some even "excellent", three wanted "creamier" milk; one wanted, two deplored Sunday deliveries; one complained of noisy deliveries; two of cracked bottles; one of "non-souring" quality, and two of "sour" milk; two wanted ½ pint bottles re-introduced, and five wanted to be able to buy bulk milk because it was cheaper.

*Butter*

*Questions*:

(1) Do you buy butter for use in:—
  (a) Sandwiches mainly?
  (b) Cooking mainly?
  (c) Other reasons? If so, what are they?

(2) Do you use much margarine:—
  (a) To the exclusion of butter?
  (b) As a substitute for butter?

(3) If you do use margarine, why do you buy it:—
  (a) Because it is cheaper than butter?
  (b) Because you like it better?

(4) Would you use more butter if the price were cheaper?

(5) Are you satisfied with the butter you now get?
  If you are not satisfied, will you please tell us why not?

(6) Do you usually get the same brand, or do you change brands:—
  (a) Occasionally?
  (b) Frequently?

(7) Do you prefer any changes to be made in the butter you now get?
  If so, what changes do you prefer?

*Replies*:

The total number was 146.

(1) 141 buy butter for sandwiches, 78 for cooking; but 62% of Bunbury housewives use it for cooking compared with 45% of Perth housewives; 40 use it for purposes other than the above.

(2) 59 never use margarine, but 85 (58%) use it as a substitute for butter, and two did not reply.

(3) 82 of the 85 margarine users buy it because it is cheaper than butter, two because they like it and one uses it only during butter shortages.

(4) 124 would use more butter if it were cheaper; 12 would not; 8 did not reply.

(5) 116 were satisfied with the butter they were getting, 28 were not, two did not reply.
Unsatisfactory quality, especially in relation to price, was mentioned by nearly all 28.

(6) 55 always bought the same brand, 48 changed brand occasionally, 11 frequently, 6 bought any available brand and 26 did not reply. (It is possible that these 26 were not satisfied either, but did not wish to say so.)

(7) 7 did not wish any changes to be made in the butter they got but 48 did and 23 did not reply.
Note: 48 wished changes to be made in the butter—not always stating what changes—compared to 28 who were not satisfied.

75% of Perth housewives, but 89% of Bunbury housewives were satisfied with their butter. (The reason for this difference is unknown.) On all other questions Perth and Bunbury housewives agreed.

The comments were (in addition to above):—All brands are alike (meant as a criticism); more salt needed; quality too variable; taste stale, poor or unpleasant; not up to standard; too watery; poor keeping quality; rancid, less yellow colouring; richer colouring; sours quickly; "at the mercy of the grocer" (many comments). Several suggested:—Wrap butter in the factory and mark off the ounces. Some preferred, others detested, Eastern States butter. It was clear that many thought the storage in grocers' shops was to blame for the unsatisfactory quality; some also that time between manufacture and consumption was too long.

*Cheese*

*Questions*:

(1) Do you buy much cheese?

(2) If you do, which kind do you prefer:—
(a) Ordinary Australian cheese?
(b) Rindless cheese wrapped in tinfoil?
(c) Foreign cheese?

(3) What do you use cheese for:—
(a) Spread on bread?
(b) With salad in your meals?
(c) Cooking?
(d) Any other ways?

(4) Do you like the cheese you get now?

(5) If you are not satisfied, will you please say what you would like to get?

(6) Are your supplies of your favourite cheese regular and uniform?

(7) If not, to what do you ascribe the variations?

(8) Have you a regular supplier of cheese?

(9) Do you usually stick to the same brand, or do you prefer to change?

*Replies*:

The total number was 139.

(1) 11 said much cheese was bought. Where stated (37 cases) the figure was about 1 lb. a week; it may be taken that about 46 bought little; two bought none.

(2) 83 bought ordinary Australian cheese.
61 rindless cheese in tinfoil wraps.
13 foreign cheese.

(3) 95 used cheese to spread on bread.
93 with salad.
68 with cooking.
16 in other ways (savouries).

(4) 80 said they liked the cheese they got, 35 said they disliked it and 4 did not reply.

(5) 29 said they were dissatisfied because they could not get—always and without change in quality—their favourite cheese, whether semi-mature; mature; wrapped, rindless or spicy foreign.

(6) 67 said the supply of their favourite cheese was regular and uniform; 35 said it was neither; and 17 did not reply.

(7) 13 (of the 35) thought the variation was the fault of grocers, 11 did not know, and 11 did not reply.

(8) 65 had a regular supplier of cheese.

(9) 83 always got the same brand or bought from the same grocer, but 34 changed frequently.

The comments were:—Quality deficiencies were specifically mentioned by a total of 62; in details: mouldy; lack of flavour; improperly labelled or wrapped; unclean taste; dry; irregular supplies; crumbly; not standardized; lack of reasonably priced varieties; improperly stored—especially in grocers' shops; poor handling; poor keeping quality; many mentioned high wastage.

More Perth than Bunbury housewives bought "foreign cheese" (Blue vein). More Bunbury (65%) than Perth (52%) housewives used cheese for "cooking".

More Bunbury (83%) than Perth (55%) housewives liked their cheese. (Is this a true difference or are the Bunbury housewives backing their "own town supply"?)

More Bunbury (75%) than Perth (51%) housewives had regular supplies of cheese. (In all other replies the two agreed fairly well.)

General comments:—The number of returns was disappointing; the interest in and desire for cheese were small; the grocers (presumably rather "storage and transport") were more often held responsible for poor quality. Clearly few people know how best to store cheese in the home.

## Final Comments

The results are illuminating, but still not sufficiently comprehensive. Certain criticisms can be immediately met; for example, there is every reason to recommend that a system of grading cheese out of store be developed which will take into account the characteristics that consumers look for, and cheese might well be labelled accordingly. And there is every reason for the dairying industry to inform housewives of the best methods of buying, storing and using cheese.

However, major problems still remain: Should the whole of Australia be subject to more searching enquiries regarding dairy products? Should we have enquiries such as are frequent in the U.S.A. (Horsley-Smith 1954; Eppright 1950), or Great Britain (Sheppard and Carrinci 1955). Who should bear the cost? Who should publish?

These questions are posed to invite comments and criticisms. The present enquiry—and it must be emphasized that it is a pilot survey only—was done by voluntary labour. Even so, it was not cheap, considering the time it took. However, it was, in our view, valuable, not not only for its results, but for the fact that nearly all fractions of the W.A. dairying industry participated.

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# THE USE OF THE RED LEAF STRAIN OF SUBTERRANEAN CLOVER FOR RAPID EVALUATION OF STRAIN EFFECTIVENESS IN *RHIZOBIUM TRIFOLII*

By J. BROCKWELL

**Summary**

A new technique is described for assessing the effectiveness of nitrogen fixation by strains of clover nodule bacteria. It is based upon the disappearance of anthocyanin pigmentation from the leaves of the Red Leaf strain of subterranean clover when that plant is effectively nodulated.

With this technique significant differences between effectively and ineffectively nodulated plants can be detected on the eighteenth day after inoculation, or nine days after nodulation. On older plants the technique is more accurate than the standard method for determination of effectiveness based upon plant growth.

## Introduction

The anthocyanins, characterised by red or blue pigmentation, occur throughout the vegetable kingdom and, dissolved in cell sap, may be found in all plant organs (Blank 1947). It has been reported that a low level of available nitrogen is associated with high anthocyanin content in oats (Heller 1948) and Virginia creeper (Behrens 1952). Anthocyanin pigmentation of the runners of white clover is a symptom of nitrogen deficiency and is most pronounced under high light intensities when the red colouring may extend into the leaves (Andrew 1956). It is well known, and has been observed frequently in this laboratory that uninoculated clovers and medics grown on a nitrogen-free agar medium in test tubes may develop a slight pink to purplish-red colouration in the hypocotyl, stem and petioles, apparently due to anthocyanin accumulation. The colour disappears when a source of nitrogen is made available.

The Red Leaf strain of subterranean clover is an anthocyanin-rich plant and, under normal field conditions, its leaves are strikingly pigmented red. In the reduced light intensity of a glasshouse it is known to produce normally-coloured green leaves when adequately supplied with available nitrogen. This change in colour also occurs when the plant is nodulated by an effective nitrogen-fixing strain of *Rhizobium trifolii*, but not when nodulated by an ineffective strain. The change in leaf colour from red to green (first observed by Professor J. M. Vincent, personal communication) may therefore be used to distinguish between effective and ineffective strains of clover nodule bacteria.

The object of this communication is to compare the standard method of evaluating bacterial strain effectiveness, which is based upon plant growth, with a visual estimate based upon the disappearance of anthocyanin from the leaves of effectively nodulated plants. Preliminary experiments have indicated that estimates of effectiveness by colour may be made at a much earlier stage than from dry weight determinations.

## Techniques Used and Results Obtained

Plants were grown under bacteriologically-controlled conditions using the technique first described by Thornton (1930). Seeds of the Red Leaf strain of subterranean clover (Canberra accession No. 540) were surface sterilised, sown on nitrogen-free mineral salts agar slopes,

*J. BROCKWELL, D.D.A. is a Technical Officer with the Division of Plant Industry, C.S.I.R.O., Canberra.*

refrigerated at 4°C-6°C for two days to break dormancy (Loftus Hills 1944), allowed to germinate at 20°C for a further two days and then grown in a louvred glasshouse. Observations were made daily to determine the time between inoculation and appearance of nodules. The amount of leaf pigmentation was judged by comparison against four standard leaves in which the proportion of the leaf area coloured and the intensity of the colouration varied; a score of "0" indicated absence of red colouration, a score of "4" complete and intense redness. Plants were also harvested at intervals and the top growth was oven-dried and weighed.

*Experiment I*

The first experiment was designed to determine the effect of seed size and the method of inoculation on colour changes in the leaves of plants nodulated by different strains of *Rh. trifolii* of known effectiveness. Two seed sizes were employed; small, 520 seeds per gram and medium, 280 seeds per gram. The seed was inoculated at sowing or inoculation was delayed until the seedlings were 15, 20 or 25 days old with the object of shortening the time of the test by reducing the interval between inoculation and the appearance of the first nodule. Hely (unpublished data) working with subterranean clover variety Mount Barker has found that this interval was least with inoculation at 15 days after sowing. Three strains of *Rh. trifolii* were used; SU297 effective, SU220 good intermediate and ClF ineffective. Each of the 24 treatments in this experiment was replicated eight times. Observations on leaf colouration were made at two-day intervals from the fifth day after inoculation until the thirteenth day and at three-day intervals thereafter. The unifoliolate leaf and the first, second, third and fourth trifoliolate leaves were scored individually. Two plants from each treatment were harvested on the twenty-first, twenty-eighth, thirty-fifth and forty-second days.

It was apparent that colour differences between effectively and ineffectively nodulated plants showed first in those cultures in which nodulation occurred with the least delay after germination, viz. in the no delay series. Plants from medium seed nodulated early and showed colour differences before plants from small seed. The trifoliolate leaves which emerged and unfolded at variable intervals were often difficult to score due to marked variations in intensities of colour between leaflets and did not show differences as soon as the unifoliolate leaves. For these reasons the loss of pigmentation in the unifoliolate leaves of seedlings grown from medium seed and inoculated at sowing was found to be the most reliable indicator of effectiveness.

In Table I a comparison is made be-

TABLE I.

*Comparison of dry weight of foliage with colour of the unifoliolate leaf as estimates of effectiveness in medium-seed Red Leaf clover plants inoculated with effective and ineffective strains of Rh. trifolii.*

*Experiment I—no delay, no preplanting.*

| Inoculum | Table of mean values | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Criteria | Days from inoculation | | | | | | | | | | |
| | | 16 | 19 | 21 | 22 | 25 | 28 | 30 | 34 | 35 | 37 | 40 | 42 |
| Effective | Colour (0-4) | 2.4 | 2.9 | — | 2.9 | 2.6 | 2.2 | 1.3 | 1.0 | — | 0.5 | 0.3 | 0.2 |
| | wt. (mg) | — | — | 6.0 | — | — | 6.0 | — | — | 13.0 | — | — | 17.0 |
| Ineffective | Colour (0-4) | 3.2 | 3.5 | — | 3.6 | 3.6 | 3.8 | 4.0 | 4.0 | — | 4.0 | 4.0 | 4.0 |
| | wt. (mg) | — | — | 6.0 | — | — | 4.5 | — | — | 8.0 | — | — | 5.0 |

Differences in colour values for plants inoculated with effective and ineffective strains are significant from and including the twenty-fifth day.

Differences in weights of foliage are significant only on the forty-second day.

tween unifoliolate leaf colour and foliage weight of effectively and ineffectively nodulated plants from the most successful set of treatments, viz. medium seed inoculated at sowing. It is clear that colour differences between plants inoculated with SU297 and with ClF appear earlier than weight differences of plants from the same treatments. Strain effectiveness can thus be determined from leaf colour at an early stage.

*Experiment II*

These results were sufficiently encouraging to warrant a second experiment incorporating some modifications of technique. Two seed sizes were used; medium seed, an even sample of 280 seeds per gram, and large, a variable sample having an average weight of 150 seeds per gram. To induce early nodulation of the test plant a preplanting method was used and replaced the delay treatments. The use of a preplanting period for this purpose was suggested by the work of Nutman on red clover (1953). All cultures were preplanted for 15 days with sterile subterranean clover variety Mount Barker before resowing with Red Leaf clover. The cultures were inoculated at the completion of the period of refrigeration after removal of the preplanted seedling. Six strains of nodule bacteria were used as inocula; two effective (SU297 and CC247), two intermediately effective (CC243 and CC244) and two ineffective (CC224 and ClF). Each of the twelve treatments was replicated eight times. Observations on pigmentation of the unifoliolate leaf were made daily from the tenth until the twenty-third day after inoculation and thereafter at two-day intervals. On the twenty-third day, when colour differences were showing clearly but before differences in size could be seen, half of the plants in each treatment were harvested. Nine days later differences in size as well as colour were apparent and the remaining plants were harvested.

The statistical analysis of the visual estimate of pigmentation indicated that the replicate variance is related to the mean and could be represented by a quadratic expression with the maximum at mean estimate of 2.00 and zero variance

TABLE II.

*The colour of unifoliolate leaves of plants inoculated with effective, intermediately effective and ineffective strains of Rh. trifolii and the number of replicates required to determine significant differences at 5% and 1% levels.*

*Experiment II—15 days preplanting.*

| Inoculum | Seed size | Mean leaf colour values at 16-23 days from inoculation | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| Effective (E) | Medium | 2.5 | 2.5 | 2.4 | 2.3 | 2.1 | 2.0 | 1.7 | 1.3 |
| | Large | 1.7 | 1.7 | 1.5 | 1.4 | 1.2 | 0.9 | 0.8 | 0.4 |
| Intermediate (e) | Medium | 2.7 | 2.8 | 2.8 | 3.0 | 3.1 | 3.2 | 3.2 | 3.2 |
| | Large | 1.6 | 1.7 | 1.7 | 1.7 | 1.9 | 1.8 | 1.8 | 1.7 |
| Ineffective (I) | Medium | 3.1 | 3.1 | 3.2 | 3.4 | 3.5 | 3.5 | 3.7 | 3.6 |
| | Large | 1.4 | 1.3 | 1.5 | 1.6 | 1.8 | 1.8 | 1.9 | 1.6 |

| Comparison | Seed size | Level of significance | No. of replicates for significant differences at 16-23 days from inoculation | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| E *v.* I | Medium | 5% | 46 | 19 | 11 | 6 | 3 | 3 | 2 | 1 |
| | | 1% | 79 | 33 | 19 | 11 | 6 | 4 | 3 | 2 |
| E *v.* e | Medium | 5% | — | 192 | 50 | 21 | 12 | 5 | 3 | 2 |
| | | 1% | — | 331 | 85 | 36 | 21 | 9 | 5 | 3 |

at means of 0.00 and 4.00. Given this relation one can estimate the number of replicates to show differences between means of samples drawn from populations with specified means, as significant at the 5 per cent. and 1 per cent. levels with a probability of 0.5 at least. The comparison between numbers of replicates for significance at a nominated level, assuming the sample means and variances are unbiased estimates of the population values, is the most effective way of comparing the relative efficiency of alternative measures of treatment.

The trends of unifoliolate leaf pigmentation and the number of replicates required using pigmentation as a criterion to establish differences between the medium-seed treatments at the 5 per cent. or 1 per cent. level with probability of 0.5 from the sixteenth to the twenty-third day are shown in Table II. Thus the data indicated that with eleven replications differences could be established between effectively and ineffectively nodulated plants from medium seed on the eighteenth day at the 5 per cent. level of significance or on the nineteenth day at the 1 per cent. level. Comparison between effectively and intermediately nodulated plants grown from medium seed indicated that significant differences at 5 per cent. and 1 per cent. could be established with moderate replication at 20 and 21 days respectively after inoculation.

Throughout the period of observation differences between the medium-seed treatments were greater than those between the large seed treatments. Anthocyanin pigmentation did not accumulate to the same extent in large-seed plants as in medium-seed plants; this was probably due to the greater nitrogen content of the former and may have been a reason for the superiority in this experiment of the medium-sized seed.

In Table III the foliage weights of the plants harvested at 23 days and at 32 days are compared with the colour ratings made on these days. It is clear from these figures that, of the two methods used for evaluating strain effectiveness of *Rh. trifolii* in this experiment, the one based upon a visual estimate of the amount of anthocyanin pigmentation in the unifoliolate leaves of nodulated Red Leaf clover was the more sensitive at 23 and 32 days after inoculation.

TABLE III.

*Comparison of dry weight and leaf colour as estimates of effectiveness in medium-seed Red Leaf clover at 23 and 32 days from inoculation.*
*Experiment II—15 days preplanting.*

| Inoculum | | 23 days | | 32 days | |
|---|---|---|---|---|---|
| | | Table of mean values | | | |
| | | Dry wt. (8 plants) (mg) | Leaf colour (16 plants) (0-4) | Dry wt. (8 plants) (mg) | Leaf colour (8 plants) (0-4) |
| Effective (E) | | 6.25 | 1.3 | 11.00 | 0.7 |
| Intermediate (e) | | 5.13 | 3.2 | 7.87 | 2.6 |
| Ineffective (I) | | 5.25 | 3.6 | 7.75 | 3.8 |
| | | No. of replicates for significant difference at 23 and 32 days after inoculation | | | |
| | | Dry wt. | Colour | Dry wt. | Colour |
| E *v.* I | at 5% | 11 | 1 | 3 | 1 |
| | at 1% | 19 | 2 | 5 | 1 |
| E *v.* e | at 5% | 10 | 2 | 4 | 2 |
| | at 1% | 18 | 3 | 7 | 3 |

## General Conclusions

Using the most favourable technique described above (viz. with medium seed and a preplanting period of 15 days) it has been possible to detect significant differences with moderate replication between the anthocyanin pigmentation of the unifoliolate leaves of effectively and ineffectively nodulated Red Leaf subterranean clover plants on the eighteenth day after inoculation, or about nine days after nodulation. Differences in leaf colour also appeared at a very early stage between plants inoculated with fully effective and intermediately effective strains. This method of making an early assessment of the effectiveness of strains of clover nodule bacteria was also found to be more accurate than the standard method of harvesting the plants and weighing the dried foliage.

Observations suggest that colour differences may be distinguished earliest when the time between germination and nodulation is least. It may be possible to reduce this time by preplanting for a shorter period and so detect significant differences in less than eighteen days.

Since the application of this technique is dependent upon anthocyanin pigmentation its limitations are determined by those extremes of light intensity that affect accumulation or loss of pigment. Observations of Red Leaf clover growing in the field indicate that, under these conditions of relatively high light intensity, effectively nodulated plants retain their red pigmentation. On the other hand plants grown in tube culture in a glasshouse during dull winter periods do not readily develop pigment even in the absence of a nitrogen source. Thus this technique for evaluation of strain effectiveness could not be applied to field conditions and would not be so accurate if used during the winter months.

In Australia considerable quantities of inoculant for subterranean clover are prepared each year and this technique may enable manufacturers to determine the effectiveness of their product with a minimum of delay before marketing provided that the strain Red Leaf itself is not symbiotically aberrant.

Red Leaf subterranean clover is similar to the variety Mount Barker botanically. Furthermore, extensive tests have shown that the different varieties of subterranean clover (including Mount Barker, Red Leaf, and all commercial varieties) behave similarly in symbiosis under the above pure cultural conditions (Nutman 1956, and personal communication). In the field, however, the variety Yarloop may differ from other varieties in its symbiotic behaviour (Vincent 1954), but this does not occur under the bacteriologically-controlled conditions used here. The above technique can therefore be used whenever a prompt determination of the nitrogen-fixing ability of a strain of *Rh. trifolii* is required. Cluster clover, crimson clover and berseem clover have been placed in the same sub-cross-inoculation group as subterranean clover and respond to inoculation in a similar manner (Vincent 1954). Thus the results obtained using the technique may also be applied to the testing of strains of nodule bacteria for effectiveness with those species.

Applications to other species of legumes will depend upon the occurrence of varieties in which anthocyanin pigmentation is prominent or can be increased by selection.


## Acknowledgements

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## BOOK REVIEWS

### SOIL PHYSICS

By L. D. BAVER

(*John Wiley and Sons, New York, 3rd Edition,* 1956, *pp. xvii* + 489. *Price* $7.75. (*Chapman and Hall, London,* £3/2/0)).

Since Baver's "Soil Physics" first appeared in 1940, its size has increased from 370 to 489 pages. In the process some of the older material has been rearranged and much that is new has been added. Changes in the third edition are more extensive than they were in the second.

In the preface to the first edition the statement is made that "special attention has been given to the practical interpretation of each of the different phases of the subject." It is in this direction that the main expansion has taken place in the third edition. The subjects given most extra space are irrigation and drainage to which new chapters have been allotted. These take their place beside the applied chapters on tillage and erosion (which have appeared before) and add to the usefulness of the book.

Additions have been made to the chapters on particles, consistence, structure, air, water, and temperature. On the whole, they fit comfortably into the old framework; but not always. The treatment of water retention in Chapter 7 suffers in this way as can be seen by comparing the discussion of capillary potential on page 227 (old version) with that given briefly on page 239 (new). Here the "osmotic" component is introduced uncritically and with insufficient explanation of how it fits into the earlier treatment.

Some old material has been dropped but more of it could have been pared down to allow the current points of view to be presented more emphatically. Take for example the treatment of the hydrometer as a tool for particle size analyses. When the first edition was written, the hydrometer was the subject of a controversy between those who made too much of its shortcomings on theoretical grounds and those who claimed too much for its accuracy in practice. The present 1956 account of the hydrometer is quite up to date but it reflects this uncertainty because the older material has not been brought into perspective. What is wanted is a straightforward summary of the usefulness and limitations of an instrument which now has an established place in soil work.

The author has tried commendably to standardize his terminology and to omit unnecessary terms. He has followed the recommendations of the Soil Science Society of America on permeability. In the field of water retention, he has chosen "tension" in preference to "suction" and has dropped "pF," using instead "log tension." These are reasonable steps although a case can be made for "suction" in preference to "tension."

"Soil Physics" is already well established as the leading text in its field and as a valuable reference book for workers concerned with soils and plants. In the third edition, it touches on many of the newer lines of work (more especially that done in the United States) and it is strengthened by the additional space given to applications in irrigation and drainage. There are few aspects of soil physics that are not represented and the extensive additions and excellent printing make the new edition very good value. The book is well edited but the terms "suction," "tension," and "osmotic pressure" are notable omissions from the index.

T. J. MARSHALL.

# MINERAL OILS AND THE CONTROL OF LATERAL GROWTH IN NORTH QUEENSLAND TOBACCO

By J. CALVERT

**Summary**

Thirteen highly refined colourless mineral oils were tested for their capacity to inhibit the development of axillary buds of tobacco, the top seven or eight of which are stimulated to grow by excision of the inflorescence.

A single dose of 2.5 mls to 3.5 mls significantly inhibited the growth of these apical suckers.

The control of sucker growth with oil was equivalent to the control obtained by repeatedly hand suckering or the natural control in intact plants due to apical dominance.

The time taken to top and treat the crop with oil was estimated at less than one tenth the time required to obtain the same control by hand suckering.

No pathological symptoms which could be attributed to the use of the oils, were observed in the crop, nor were there any adverse effects on the quality of the cured leaf.

## Introduction

Decapitation or "topping" of tobacco plants at flowering time has important effects on the type and grades of the cured leaves, as well as on the yield (Garner 1951). The removal of the inflorescence, however, acts as an immediate growth stimulus to the upper seven or eight axillary buds. If these are permitted to grow into laterals or suckers any improvement in yield or quality of the harvested leaf accruing from "topping" is largely nullified. Suckers are usually removed from each plant throughout the crop by hand and this operation must be repeated frequently during the five or six weeks' harvesting period.

Previous work has shown that the apical dominance of "topped" tobacco plants can be maintained by treating the stem with certain synthetic growth regulators (Steinberg, R.A. 1947; Calvert 1948, 1953). There was, however, little tolerance between a concentration which effectively suppressed the laterals and one which induced pronounced epinastic effects on the upper leaves. Pal and Kadam (1949) in India, suppressed the sucker growth without causing leaf distortion by treating the axillary buds with petroleum jelly and various mineral oils and fats; while Peck, Peterson and Anderson (1950) in the U.S.A. also claimed control by daubing the cut stem with mineral oil or spraying the upper part of the plant with maleic hydrazide. Under Queensland conditions a single treatment with maleic hydrazide gave limited control compared to that obtained with mineral oils (Calvert 1953). The oil acts as a selective herbicide, killing the axillary buds or the tender tissues of young suckers but has little or no effect on the older tissues of the parent plant.

In the United States the occurrence of a bacterial infection of the stem cortex and pith, known as Soft Rot, has been reported in plants treated with oil (Wilson *et al.* 1952; Dietrick 1953). This has probably reacted against a wider acceptance of the method. These losses have been attributed to the use of too much oil, enabling it to reach the root system, but such losses have been obviated by using a 50/50 emulsion of the oil and water. This result is probably due to less oil being applied and a reduced capacity to creep rather than a reduction in toxicity of the oil when emulsified. Soft Rot is more prevalent under conditions of high rainfall, temperature and humidity than in a hot, dry season. This disease has

*J. CALVERT, D.Sc., is a Research Officer in Tobacco Physiology with the Division of Plant Industry, C.S.I.R.O., Canberra.*

not been observed in any of the experiments in North Queensland where most of the tobacco is grown during the dry season under irrigation. A disease known as Stem Rot has been reported in North Queensland but its occurrence has not been associated with the use of oils. In the season 1951-52 Stem Rot was reported in the crops at Mareeba but there were no sucker control experiments at Mareeba that year. The organism was identified as a *Fusarium* sp. by the State pathologist. The following season some plants with Stem Rot were found in the experimental areas but diseased plants were also found in an adjoining area not associated with the experiment. The pathogen this season was indentified as a *Pythium* sp. There was not any Stem Rot in the 1953-54 season. It would seem therefore that the occurrence of these infections is not associated with the use of oils. No information is available to indicate whether the losses due to these fungal diseases are aggravated in plants treated with oil.

The earlier field experiments were conducted at Clare, North Queensland, and this present work was extended to Pioneer and Mareeba and included a number of oils not previously tested. The effect of the treatments on the quality of the cured leaves was also investigated and is the subject of a separate paper.

## Definition of Oils

The oils used in these experiments were obtained as highly refined mineral oils of negligible aromatic content. They are odourless, non-toxic to humans and do not adversely affect the appearance or quality of the cured leaf. Determinations of "per cent. aromatics" by treatment with $H_2SO_4$ — $P_2O_5$ gave zero or negative values for seven of the oils, and up to 2.0% v/v for the remainder except Risella 17 which registered 7.5% v/v. Ultraviolet spectra were also determined since aromatics show characteristic absorption bands in the region 0.2 to 0.4 microns. Per cent. transmission curves of the oils all had the same general trend with a definite minimum at 270 m$\mu$ probably due to substituted tetralins. Thus, there was at least a trace of aromatics in all of the oils used.

## Action of Oils on the Plant

The mechanism of selective action between species is not fully understood. Stomata are regarded as the main means of entry into the plant but in young tissues the epidermis can be penetrated directly (Minshall and Helson 1949). This is likely the basis of the selective action of the oils on tobacco, the stem of the plant having a high tolerance while the dormant axillary buds or small laterals are susceptible. The actual toxicity of the oils is probably due to the influence of the aromatic fraction in increasing the permeability of the plasma membranes. (Currier 1951; Overbeek and Blondeau 1955). This increase eventually leads to a loss of semi-permeability resulting in collapse of the young cells.

Apart from the inherent toxicities of the individual oils their effectiveness depends on actual contact being made with the axillary buds. Their low surface tension and the chemical affinity for the fatty substances of the cuticle facilitate the wetting of the stem. They creep over the surface, gravitating from node to node so long as the film is thick enough to permit free downward movement. Bentley and Wolf (1945) showed that the density of trichomes on the upper parts of some tobacco varieties was about 3000 per $cm^2$, but the gravitational creep is little hindered by these epidermal hairs. They may, however, offer some resistance to the travel of an oil-water emulsion. The movement of Light Medicinal Oil down the stem of a number of plants selected for uniformity in height, was measured. The plants were topped at 54 inches above ground level and dosages from one ml. to five mls. were applied to the cut end from a pipettte. There were four replicates

of each dose and the distances travelled were measured seventeen hours later. The expression $y = 10^a x^b$ was fitted to the data by the method of least squares. The equation

$$y = 33.54x^{0.243}$$

is graphed in Figure 1 and the original data, given as a mean distance travelled for each dosage, are superimposed. The graph indicates that 2.5 mls. to 3.5 mls. is sufficient oil to travel most of the length of the stem and still minimise the risk of it reaching the root system. The same dosage was used for all the oils, and although the creep of the separate oils was not measured, it was observed that they all travelled most of the length of the stem.

Normal care when applying the oil at "topping" time ensures that it is confined to the stem. In travelling down the stem some oils caused a brown discolouration of the upper part of the stem and a burning of the edges of the wings of the uppermost young leaves. This effect was apparent a day or two after treatment and was most noticeable in plants treated with Bayol N-150 and to a lesser extent with White Oil W-150, White Oil No. 30 and Ondina 17. Light Medicinal Oil also occasionally affected the young top leaves. The burned appearance of these upper leaves diminished with time until towards the end of the harvest the damage was not obvious. In practice these tip leaves are not always harvested.

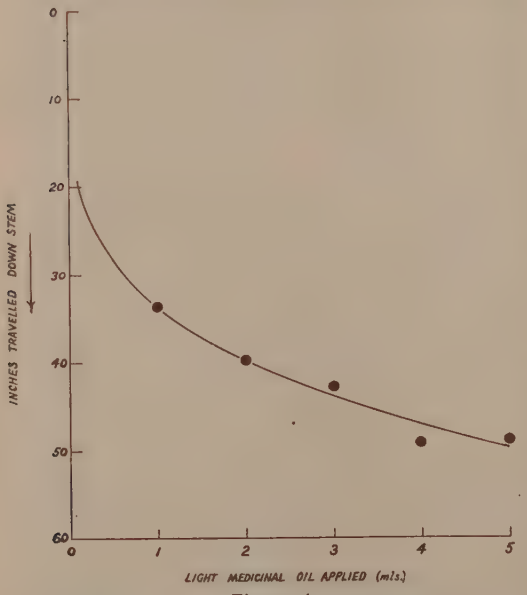


Figure 1.
Gravitational creep of Light Medicinal Oil down the stems of topped tobacco plants.

### Experimental Areas and Methods

The experiments were conducted during the two seasons 1952-53 and 1953-54, in the tobacco growing districts of Clare and Pioneer on the Burdekin and Mareeba on the Atherton Tableland. The areas at Pioneer formed part of the crop of the growers while the areas at Clare and Mareeba were on the State Department's Tobacco Stations. In all there were seven areas of tobacco, grown under spray irrigation and the same agronomic practices as the commercial crops of the districts. Thirteen mineral oils were used. The three controls were (a) "not topped" where the sucker growth was naturally inhibited, (b) "topped only" where the plants were decapitated and the suckers allowed to grow and (c) where the plants were decapitated and the suckers removed by hand at intervals during the harvests. The names of the individual oils are given in the combined table of results. The plants receiving the oil treatments were topped with special secateurs (Calvert 1952) which automatically applied the oil over the cut end of the stem. The dose varied between 2.5 mls. and 3.5 mls.

The plants in the seven experimental areas were suckered manually before commencing the treatments, which were applied shortly after the first few flowers of the inflorescence had opened. The treatments in each of the areas were randomised within blocks. The Burdekin experiments had three replicates each season, and at Mareeba two replicates in 1953 and five in 1954.

The harvests synchronised with those of the commercial crops and the leaf was

cured as commercial leaf. Each cure was bulked to await grading, the results of which are reported in another paper.

Following the final harvest, the suckers on each plant were removed and weighed. It is the upper seven or eight axillary buds which normally develop into suckers, and so the sucker weights per plant arising from the top ten nodes were recorded. Any other sucker growth was weighed as basal suckers. As a check against variations in sucker growth being due to differences in the size or vigour of the plants, stem heights and weights were determined. These results are not included since there were not any significant differences between the plants of any one treatment and another.

## Results and Discussion

Separate statistical analyses of the mean weight of sucker growth in the seven experiments indicated significant differences between the controls and the oils and within the oils. However, the more effective oils in one experiment were not consistently so in the others. To facilitate presentation and in an effort to obtain some measure of differences between oils, the data for apical sucker growth of the seven experiments were combined into a single table for treatments, location and year. Two analyses were made on the data. The first analysis was on the data for the three types of control and the thirteen oil treatments at Clare and the two farms at Pioneer in 1953, together with the Mareeba 1953 data for the same controls and nine of the oils. The second analysis was on the data for the two controls "topped only" and "not topped," and four oil treatments for all locations and both seasons. Table I gives the combined means for the weight of apical sucker growth in the two analyses.

### (a) *The Controls and Oil Treatments*

The outstanding result in Table I is the three to four-fold greater weight of suckers on the plants that were "topped only" as compared with the sucker weights of all other treatments. This increased weight of suckers is a function of the growth stimulus to the axillary buds immediately below the point of topping, and it is this growth that must be controlled for any advantages to accrue from topping.

In the intact plants, as the seed capsules of the apical inflorescence near

TABLE I.

*Mean weight of sucker growth per plant from the top ten nodes. Mean of* 190 *plants in Column* 1, *and* 580 *in column* 2.

| Treatment | Clare Pioneer (Farm 1 & 2) Mareeba 1953 (gms) | Clare Pioneer Mareeba 1953 and 1954 (gms) |
|---|---|---|
| Topped only | 579.5 | 504.2 |
| Not topped | 174.8 | 170.0 |
| Topped and hand suckered | 211.7 | |
| Liquid Paraffin | 149.2* | |
| White Oil No. 4 | 161.0* | |
| 50/50 Mixture L.P. and W.O.4 | 204.1* | |
| Light Medicinal | 205.1 | |
| Ondina 33 | 169.4 | |
| Ondina 29 | 131.2* | |
| Ondina 21 | 192.6 | 168.2 |
| Ondina 17 | 172.6 | |
| Risella 17 | 151.2 | |
| Technical White Oil No. 30 | 152.0 | |
| W-150 | 215.0 | 194.5 |
| Bayol N-150 (Flit 400) | 232.2 | 174.3 |
| White Oil No. 1 | 172.5 | 162.3 |
| *Least difference for significance at* 5% | | |
| Between complete treatments | 116.7 | 77.4 |
| Complete and one missing | 129.4 | |
| Both with one missing | 134.8 | |

*Adjusted means of treatments with one missing value.

maturity, the dominance of the apical point or young inflorescence decreases. Successive axillary buds develop and it is the laterals below the normal topping position that are regarded as suckers. When topped and suckered at intervals by hand the mean sucker weight per plant at the final harvest is given in Table I and does not include the sucker growth removed at intervals during the harvesting period. It should be noted that hand suckering is usually performed when the growth rate is at a maximum, thus maintaining a relatively high rate of drainage of assimilates and nutrients from the plant. The weight of suckers on the plants of these two controls, "not topped" and "topped and hand suckered" at the completion of the harvest was not significantly different to the cumulative weight of sucker growth on the plants which received a single dose of oil when "topped."

### (*b*) *Comparison of Oil Treatments*

The analyses of the data of the individual experiments indicated that some oils were significantly better than others but were not consistently so for the different locations and seasons.

Since the axillary buds or the tissues of young suckers are killed by contact with the oils, any difference in sucker control would be associated with the creep of the oils. All the oils travelled most of the length of the stem, but a lateral creep could increase the chance of contact with the axillary buds. The viscosity of the oils varied from 19.90 cs to 110.55 cs but there is no relation between effectiveness and viscosities (Table I). Incidentally, the crop itself could lead to differences in a single treatment in two locations. The leaf wings subtending the stem successively channel the oil from one node directly towards an axillary bud below. This sequence can be upset in stems a certain angle off the vertical. In these the oil tends to flow to the lower side of the stem thus missing a number of buds. These oil-free buds are then free to develop and may grow into abnormally large suckers due to the increased stimulus from the oblique angle of the stem and the sucker growth being restricted to one or two centres.

The statistical treatment of this combined data for locations and seasons does not show any significant differences between the effectiveness of the oils in inhibiting the sucker growth.

### (*c*) *Basal Suckers*

Effective control of the sucker growth from the upper axillary buds often stimulates suckers to develop from the base of the plant. The oil does not always reach the basal buds, especially if the seedlings were transplanted at an angle, which gives the stem of the mature plant a decided bend just above ground level. However, basal suckers are not the same problem as normal suckers, since they can be removed when the basal leaves are being primed, or simultaneously with the early harvests.

### (*d*) *Comparison of Time for Hand Suckering and Oil Treatment*

The time necessary to "top and treat" a crop with oil as compared to manual suckering is a matter of practical importance. Topping usually coincides with the first harvest and is easy and quick relative to the suckering that ensues. It has been estimated that the cumulative time required to sucker a given area three times by hand, exceeds twenty times that required to top only. A study made on several hundred plants gave a mean time of topping of 5.43 seconds per plant and of topping and treating with the applicator of 10.03 seconds. With equivalent sucker control by hand and by oil, the time spent on the latter is about one-tenth of the time on the former operation.


### Acknowledgements

Acknowledgements are made to the Queensland Department of Agriculture and Stock for the use of land at Clare and Mareeba; Mr. E. M. McDonald, the Department's Tobacco Officer at Mareeba

for his care of the crop and full co-operation throughout the experiments; the Pioneer Sugar Mill for the use of part of their growers' crop. The individual oils used were kindly supplied by the Atlantic, Shell and Vacuum Oil Companies. My thanks are also due to Mr. G. A. McIntyre and Mr. M. L. Dudzinski for the statistical treatment of the data and Mr. E. Greenhow, Coal Research Station, C.S.I.R.O., for the determinations of viscosity and per cent. aromatic content.

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## BOOK REVIEWS

### ANALYSIS OF INSECTICIDES AND ACARICIDES

By FRANCIS A. GUNTHER and ROGER C. BLINN

(*Published by Interscience Publishers, Inc.*, 250 *Fifth Ave., New York* 1, *N.Y., U.S.A.*, 696 *pp.*, (*U.S. price* $14.00)).

This is not a book for the general reader, but a specialised text-book for use in the chemical laboratory. It is the sixth member of a series of volumes dealing with different aspects of chemical analysis, and as indicated by the title, is directly concerned with the analysis of insecticides and acaricides (pesticides used in the control of spiders and mites). Particular emphasis is laid on the determination of residues of these materials on fruit and other foodstuffs, and the book was primarily written to draw attention to this field.

Over the past ten years or so, there have been great advances in the production of new types of pesticides, largely complicated organic compounds. It is not an easy task to keep abreast of these, and the chemist who has to analyse them, in technical grades or formulated products, or as residues, must often carry out much investigation, either in the literature or in the laboratory, in order to arrive at suitable methods of analysis. This book fills a definite need, as it brings together tried methods for about 90 insecticides and acaricides. In each case, a general description of the method is given, together with details of the procedure. References to relevant literature are freely given, so that original papers may be consulted.

The volume contains almost 700 pages, of which about 350 are given over to descriptions of analytical procedures. The remainder of the book contains chapters on sampling, methods of removing residues prior to analysis, discussion of the various physical and chemical methods used, etc. A particularly useful appendix contains detailed curves and derived data of ultraviolet and infrared absorption spectra for a number of insecticides and acaricides.

This is a good book, clearly written, and should be an acquisition to the library of every chemical laboratory dealing with pesticides.

F. H. WILLIAMS.

# LEAF QUALITY IN FLUE-CURED TOBACCO IN NORTH QUEENSLAND AS INFLUENCED BY SUCKER GROWTH AND LEAF MATURITY

By J. CALVERT

**Summary**

The effect of sucker growth and variation in maturity of the harvested leaf from plants grown on these low nitrogen soils were investigated relative to the incidence of worthless leaf.

The control of sucker growth in plants which have been topped, either with a single application of oil or by frequent hand suckering, significantly reduces the incidence of worthless leaf in the cured crop.

The leaves normally picked at each harvest have a range of maturity and the worthless cured leaves arise from the over-mature fractions.

The elimination of such "sinks" as inflorescences and suckers slows down the rate of senescence and consequently narrows the maturity range within the leaves of each harvest.

## Introduction

Tobacco grades are based on the use to which the manufacturer can put the cured leaf and this is determined by certain physical and chemical properties of the leaf. These properties are associated with the nodal position of the individual leaves on the plant. The best quality normally comes from the middle of the plant. Above this mid-section are the "leaf" grades, the quality of which decreases towards the "tips", and below the mid-section the leaves are subdivided into the "lug" grades. In the U.S.A. the lowermost leaves on the stem give rise to "scrap trash" and the leaves immediately above these to "trash lugs". These two trash grades are inherent to the basal leaves and have a commercial value. In Australia these two grades do not exist as such but leaf, known as "trashy leaf", comes from the same general position on the plant and, as defined below, is worthless.

Climate is recognised as a determining influence on quality and the vagaries of the weather are an annual risk which affect the proportion of the total production falling into the different grades (Darkis *et al.* 1935, 1936, 1937). Low quality crops, for example, can result from excessive rain during the maturation or ripening of the leaf. The individual trashy leaf has recently been defined as one which is "extremely thin, brittle, brown in colour, has a low carbohydrate content, a low weight per unit area and does not readily take up moisture" (Johanson 1951). Its occurrence was attributed to the effect of "constraints of soil nitrogen, temperature and sunlight" on the growing plant and was independent of ripeness or curing. The worthless leaf referred to in this paper occurs in all seasons.

Leaves with an insufficiency of carbohydrates when harvested suffer somatic disorganization during curing and become worthless. The onset of the reproductive phase of growth in the plant is accompanied by a progressive senescence of the leaves from the base of the plant upwards. With advancing senescence labile food reserves flow out of these leaves. Removal of the inflorescence or lateral growth slows down the rate of senescent changes and in practice should result in improved leaf quality.

The purpose of the present paper was to determine whether sucker growth and ripeness of leaf when picked, significantly affected the incidence of worthless cured leaves found in the North Queensland tobacco crop each season. The data were obtained from field experiments at Clare

*J. CALVERT, D.Sc., is a Research Officer in Tobacco Physiology with the Division of Plant Industry, C.S.I.R.O., Canberra.*

and Pioneer on the Burdekin and at Mareeba on the Atherton Tableland, where sucker growth was (a) controlled manually and (b) significantly inhibited with mineral oils.

### Procedure

The growing of the crop was in accordance with district practice. Oil treatments for the inhibition of sucker growth were applied when the crop was coming into flower, a stage which normally precedes by about a fortnight or less the first harvest.

Harvesting begins when the bottom leaves start to turn yellow, and it is usual to pick from one to four leaves from each plant. At this time there are approximately twenty-five leaves per plant. Harvesting is repeated at intervals as successive leaves approach an equivalent stage of ripeness or senescence. A detailed study was made at Mareeba of the relation between the colour of the leaf at harvest and quality grade of the cured leaf. The freshly picked leaves of each plot or treatment of the separate harvests were subdivided into groups based on the depth of greenness or the extent of yellowing, which supplants the green colour as senescence advances. These subdivisions of plot harvests were cured with the commercial leaf picked by the grower at the same time. The cured leaves were subsequently placed into grades by an independent grader and the number of leaves in the different grades recorded. Grading is the last operation before marketing and it is not until this process that the quantity of worthless leaf becomes evident. Data which were collected over two seasons were confirmatory for all trials; the results for the Pioneer 1953-leaf and the Mareeba 1954-leaf are given.

### Layout and Results

#### (*a*) *Pioneer 1953-leaf*

Thirteen different oils and the three types of control nominated in Table I were randomised in three blocks, each plot having forty plants. The experiment was replicated on three farms, and the experimental leaf, on all occasions, was cured by the owner concerned. The lemon, mahogany and green-cast grades were grouped as "grade" leaves to be compared with the "worthless" leaves. The percent. of worthless leaf per plot was computed for each harvest. The harvests were grouped into three periods of about equal total yields in order to reduce sampling fluctuations. The first period ($H_1$) included the first two harvests and consisted of the lower leaves. The second period ($H_2$) covered the lower middle to upper middle leaves and the third period ($H_3$) included the top leaves picked in the last two harvests. This subdivision is also approximately in conformity with the quality grading determined by chemical composition and stalk position (Darkis *et al.* 1937). An analysis of variance was done on the grade data from the three farms when it was finally grouped into the harvest periods for the three types of control and thirteen oil treatments. The experience over the separate trials of the effect of the individual oils showed that there was no consistent difference between them. In presenting the data the mean of the oil treatments is given, together with differences for significance between this mean of grouped treatments and the remaining treatments. The means for treatments and harvest periods are given in Table I. The leaf maturity aspect of the separate harvests is not considered in this crop.

In the 2.1 treatment of Table I, where the axillary growth was inhibited naturally by the intact inflorescence which was allowed to mature and set seed, the amount of worthless leaf was equivalent to that in the "topped only" treatment (1.1) and was significantly greater than when the growth of suckers was controlled. The Table also shows a significantly greater proportion of worthless cured leaf from the lower leaves of the plant, which are included in the early harvests, than in the harvests of the

TABLE I.

*Mean per cent. of worthless leaves in three replicate experiments at Pioneer, 1953.*

| Treatment | Mean per cent. worthless at separate harvests | | | Mean per cent. worthless over all harvests |
|---|---|---|---|---|
| | $H_1$ | $H_2$ | $H_3$ | |
| 1. Suckers not controlled | | | | |
| 1.1 Topped only | 53.0 | 32.0 | 25.7 | 36.7 |
| 2. Suckers controlled | | | | |
| 2.1 By intact inflorescence (not topped) | 49.3 | 20.7 | 25.3 | 31.7 |
| 2.2 By hand | 48.3 | 16.3 | 12.7 | 24.3 |
| 2.3 With oils* | 43.5 | 17.3 | 14.8 | 24.5 |
| Harvest means | 44.7 | 18.4 | 16.0 | |

Least difference for significance at 5%:—
Between harvests .. .. .. .. = 19.3
Between oils and the rest .. = 6.7
Within the rest .. .. .. .. = 9.1

*The oils used were Liquid Paraffin, White Oil No. 4, a 50/50 mixture L.P. and W.O.4, Light Medicinal Oil, Ondina 33, 29, 21 and 17, Risella 17, Technical White Oil 30, W-150, Bayol M-150, White Oil No. 1.

middle and top leaves. The data gave no evidence of an interaction effect between treatment and harvest.

*(b) Mareeba 1954-leaf*

The same three types of control but only five oil treatments were randomised within five blocks. Each block contained approximately 280 plants. There were seven harvests extending from the 30th December to the 5th February, 1954.

The freshly picked leaves of the first and last harvests were subdivided into as many as six maturity classes, but in the intervening five harvests the plot yields were divided into two classes only. After curing, and a period of time in bulk, the classified plot yields of the seven harvests were graded, and the harvests were again grouped into three as at Pioneer. $H_1$ included the first two harvests, $H_2$ the next three and $H_3$ the

TABLE II.

*Mean number of leaves per plot for complete harvests.*
*(Percentage yields in the grades in brackets)*
*Mareeba, 1954.*

| Treatment | Quality | | | | | |
|---|---|---|---|---|---|---|
| | Grade leaf | | Green leaf | | Worthless leaf | |
| 1. Suckers not controlled— | | | | | | |
| 1.1. Topped only .... .... .... .... | 323.4 | (55.36) | 6.2 | (1.06) | 248.4 | (42.88) |
| 2. Suckers controlled— | | | | | | |
| 2.1 By intact inflorescence .. | 305.8 | (55.62) | 19.6 | (3.98) | 212.4 | (38.58) |
| 2.2 By hand .... .... .... .... .... | 361.4 | (67.64) | 32.0 | (6.58) | 144.2 | (25.66) |
| 2.3 by oils* .... .... .... .... .... | 366.3 | (65.35) | 34.3 | (6.20) | 149.4 | (26.57) |
| *Least difference for significance at 5% level* | | | | | | |
| Between oils and the rest .... | 66.8 | (7.49) | N.S. | | 50.5 | (7.46) |
| Within the rest .... .... .... .... | 86.3 | (9.66) | | | 65.2 | (9.63) |

*The oils used were Liquid Paraffin, Ondina 17, W-150, Flit 400 and White Oil No. 1.

last two harvests. The leaf quality grades were grouped as before except that leaves with a green-cast were recorded as "green".

(i) *Treatment effect.*

Table II shows that an improvement in the quality of the cured leaf is obtained when the sucker growth and the formation of seed are controlled. The worthless leaf is reduced, the lemon and mahogany "grade" increased while the amount of green-cast leaf remained unaffected.

The lemon and mahogany "grade" leaf averaged 66 per cent. of the yield where suckers were controlled as compared with 55 per cent. where suckers and seed formation were uninhibited. These percentage increases are significant for both hand suckering and oils. The significant reduction in worthless leaf and the significant increase in lemon and mahogany "grade" when suckers are controlled means that the potential grade leaf is not degenerating into worthless leaf during the curing.

(ii) *Stalk position or harvest effect.*

The percentages of lemon and mahogany "grades", green-cast and worthless leaves in each period were then determined and analysed. These are given for the three harvest periods for suckering plants, intact plants and suckered plants in Table III.

In no case was the interaction of treatment and harvest significant. The main purpose of the analysis was to show the harvest effects. Table III indicates clearly that the percentage worthless leaf was very much greater in the early harvest than in the subsequent harvests, the differences between the three were significant at the 0.001 level. The number of "green-cast" leaves was not significantly different from one harvest to another. As the treatment effects could be distorted by a time lag of maturity in one treatment relatively to another, the best appraisal of treatment effects would appear to be given by the pooled harvests. Tables II and III show that the per cent. of worthless leaf in the total yield was approximately 26 per cent., where the suckers were controlled (treatments 2.2 and 2.3) as compared with 43.0 per cent. in the plants with unrestricted sucker growth (1.1) and 38.0 per cent. where the inflorescences developed and set seed (2.1). This holds good for the individual groups. In the early harvests ($H_1$) the change in percentage was from approximately 49 per cent. to 61 per cent., in the middle harvests ($H_2$) from 13 per cent.

TABLE III.

*Percentage of leaf in each grade in the early ($H_1$), middle ($H_2$) and late ($H_3$) harvest groups.*
*Mareeba, 1954.*

| Treatment | Lemon-Mahogany | | | Green-cast | | | Worthless | | |
|---|---|---|---|---|---|---|---|---|---|
| | $H_1$ | $H_2$ | $H_3$ | $H_1$ | $H_2$ | $H_3$ | $H_1$ | $H_2$ | $H_3$ |
| 1. Suckers not controlled— | | | | | | | | | |
| 1.1 Topped only .... .... .... | 39.5 | 72.2 | 50.8 | 0.4 | 2.5 | 0.2 | 60.1 | 25.3 | 48.1 |
| 2. Suckers controlled— | | | | | | | | | |
| 2.1 Intact inflorescence .... | 31.0 | 77.5 | 59.0 | 7.2 | 1.8 | 2.0 | 61.8 | 20.7 | 31.6 |
| 2.2 By hand .... .... .... .... | 43.0 | 80.0 | 83.6 | 7.8 | 5.4 | 3.8 | 49.2 | 14.6 | 12.2 |
| 2.3 by oil .... .... .... .... .... (means of five) | 43.2 | 80.5 | 74.0 | 6.7 | 8.3 | 2.8 | 48.1 | 11.3 | 20.6 |
| Total mean weighted .... .... | 41.2 | 79.0 | 70.4 | 6.1 | 6.4 | 2.5 | 51.4 | 14.6 | 24.4 |

*Least difference for significance between means at 5% level*

| | Treatments | Treatments | Treatments |
|---|---|---|---|
| Between oils and the rest .... | 7.7 | N.S. | 8.4 |
| Within the rest .... .... .... .... | 9.9 | | 10.9 |

TABLE IV.

*Per cent. quality grades of cured leaf in pre-curing classes. Mareeba, 1954.*

| Quality Grade | Maturity letter at harvest | Harvest | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Lemon-Mahogany .... | a | 57.2 | 87.9 | 86.6 | 88.9 | 87.3 | 90.4 | 91.2 |
| | b | 14.1 | 36.1 | 39.3 | 20.4 | 69.8 | 60.0 | 37.0 |
| Green-cast .... .... .... .... | a | 24.7 | 7.9 | 8.5 | 2.5 | 11.3 | 7.9 | 2.5 |
| | b | 0.5 | 0.7 | 0.5 | 0.3 | 4.6 | 0.9 | 0.1 |
| Worthless .... .... .... .... | a | 18.2 | 4.2 | 4.9 | 8.6 | 1.4 | 1.5 | 3.9 |
| | b | 85.9 | 63.2 | 60.2 | 79.3 | 25.6 | 37.7 | 54.3 |

to 23 per cent. and in the late harvests ($H_3$) from 16 per cent. to 40 per cent.

(iii) *Maturity gradient within a "pick".*

Pooling the replicates and the treatments, the percentage good, green-cast and worthless cured leaves were calculated for the maturity classes assigned to the freshly picked leaves of the seven harvests. These percentages are given in Table IV, from which it can be seen that there is always a greater percentage of worthless cured leaf in the "b", or riper leaves of the harvest, than in the class "a" maturity, and conversely in the "a" class there is a higher percentage of good leaf than in the "b" class, in all harvests. Again it is evident that the largest percentage of worthless leaf comes from the lower leaves and especially the over-mature lower leaves.

The first and last harvests which were sub-divided into more maturity classes than the other harvests are shown graphically in Figure 1.

In both these harvests the good leaf decreases and the worthless leaf increases with advancing ripeness. The larger percentage of green-cast and worthless leaf in the "a" and "b" classes of the first harvest compared to the same classes in the last harvest, and the reverse for the good grade leaf, indicates that there was a wider range of maturity in the lower leaves at harvest time than in the upper leaves when they were harvested.

The difference in the cured leaves from the pre-curing maturity classes of the two harvests are clearly shown when photographed in ultra-violet light. Figure 2 shows the fluorescence from the underside of the "grade" leaves and the almost

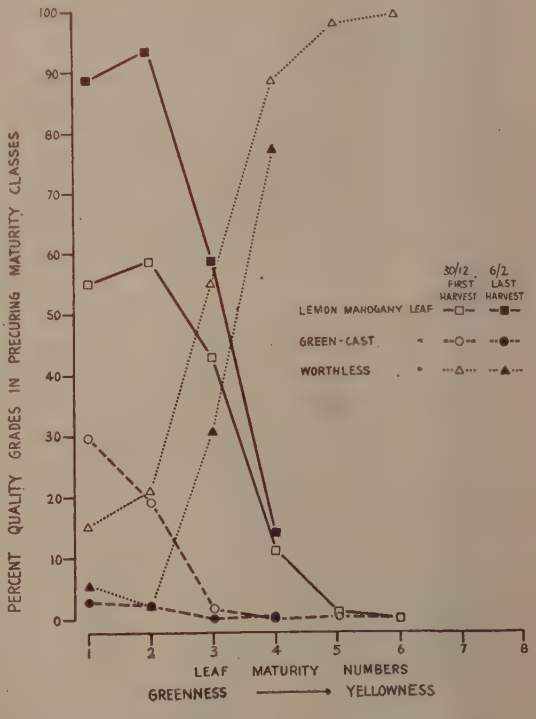


Figure 1.

The per cent. of "worthless", "green-cast" and "lemon-mahogany" cured leaves in each of the maturity ratings of the freshly picked leaf of the first and last harvests. Mareeba 1954.

Figure 2.
Fluorescence of the cured leaves from the maturity classes of Figure 1.
(1) First harvest. (2) Last harvest.

complete absence of fluorescence in the over-ripe leaves, which is similar to the result obtained by Johanson (1953) with his good quality and trashy leaf.

## Discussion

It is evident from the results that have been presented that under North Queensland conditions the incidence of worthless leaf is increased if (a) the growth of suckers, which follows the topping of the plants, is not properly controlled, and (b) the harvesting is done in such a way that ripe and over-ripe leaves are included in each curing.

Carbohydrates in the form of soluble sugars are essential for quality and these are derived during the curing process, largely from stored starch in the harvested leaves. With the photo-periodic induction of the reproductive phase of growth, complex changes within the plant are initiated which are directly concerned with maturity. Kraus and Kraybill (1918) showed, that with the approach of maturity and seed production, the carbohydrates in the plant increased and the nitrogen decreased. Vickery *et al.* (1935) in their investigations of the ontogenetic drift of carbohydrates, nitrogen and organic acids from the seedling stage to the reproductive phase of growth, demonstrated the translocation of organic and inorganic substances from other parts of the plant, particularly the leaves, into the developing seed pods. Petrie *et al.* (1939) found that topping had a retarding effect on the rate of ripening. The assimilates, which in the intact plants were utilized in inflorescence production partly remained in the leaves of the topped plants and partly migrated to the root system. Berthold (1931) found a decidedly larger root system in tobacco when topped and suckered. Since the organic reserves in the leaves increase as the plant approaches maturity, and since senescence is associated with loss from the leaves harvesting should take place as senescence is about to commence. The conservation of assimilates is regarded as the factor responsible for the reduction in worthless leaf from 34 per cent. to 24 per cent. of the leaf harvested at Pioneer and from 40 per cent. to 26 per cent. of the leaf harvested at Mareeba.

Ideally it should be possible to predict from the composition of a carefully selected and uniform batch of leaves the conditions necessary for a successful cure. Practical limitations, however, lead to variations in the composition of the leaves at any one time and consequently the curing procedure must be a compromise determined by the majority of the leaf in the barn. There is a relation be-

tween the ripeness of the fresh leaf and the time it takes to yellow. Over-ripe leaf requires from 30 to 36 hours, ripe leaves from 36 to 48 hours and immature leaf from 50 to 56 hours (Garner 1951). The variation in time for leaves of different maturities to reach the required colour is the basic reason why it is so important to strive for uniformity in maturity at harvest. Infrequent harvests and picking too many leaves per plant means a wide range of maturity and leads to an undue proportion of the leaf becoming worthless. This is exemplified in Figure 1 and the objective should surely be the elimination of maturity classes 4, 5 and 6.

## Conclusions

The results indicate:—

(1) A substantial proportion of useless cured leaf in the total leaves grown and handled whether the sucker growth is controlled or not. This could be greatly reduced by more careful harvesting.

(2) A reduction in the incidence of worthless leaf from approximately forty per cent. to twenty-five per cent. resulting from the inhibition of the development of inflorescences and suckers.

(3) Another source of serious loss arises from over-ripeness and to a lesser extent under-ripeness in the leaves picked, as "ripe", for curing. When the "ripe" and "more ripe" leaves of each harvest were divided into two maturity groups, before placing in the barn to be cured, the per cent. content of the three types of cured leaf in the crop were quite different for the two groups. The crop yield for the ripe group consisted of nine per cent. green-cast, eighty-four per cent. lemon-mahogany and six per cent. worthless leaves while the riper group comprised 1 per cent. green-cast, forty per cent. lemon-mahogany and fifty-eight per cent. worthless leaves. That means that approximately five per cent. of the leaves cured were immature at harvest and thirty-two per cent. lost due to over-ripeness at harvest.

(4) The grower, on the grounds of economy in fuel and labour tends to delay picking until confident of picking enough leaf to fill the curing barn. More frequent and careful harvesting of uniformly ripe leaves would greatly reduce the degeneration during curing, of potentially good leaves to worthless leaves. The economies resulting from running a cure only when a full barn is available may be completely offset by the losses associated with this procedure. It seems desirable that growers should have barns of varying size so that the volume of any pick can be adequately housed.


## Acknowledgments

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TECHNICAL NOTES

# NODULATION OF CLARE SUBTERRANEAN CLOVER IN RELATION TO ACID AND BASIC SUPERPHOSPHATE PLACEMENT


**Summary**

When inoculated Clare subterranean clover seed was sown separately or in contact with acid or very basic molybdenised superphosphate on an acid podsolic soil PH 5.2 good nodulation was recorded using commercial molybdenised superphosphate placed 2 inches below the inoculated seed.


## Introduction

No field information has been cited which refers directly to experiments designed to explore the relationship between the nodulation of subterranean clover and the separate placement of fertiliser, i.e. where acid or basic superphosphate are drilled separately to the inoculated clover seed on acid soils.

Three methods of superphosphate placement are described by Jacques (1943) in which it was found that in the establishment year white clover exhibited a greater number of nodules in the surface applied fertiliser treatment. Anderson and Spencer (1948) have reported that good nodulation may be expected on acid soils where the inoculated subterranean clover seed is drilled with two cwt agricultural lime per acre.

Fertiliser placement studies by Cooke and Widdowson (1953a, 1953b) showed peas and beans responded equally well to a single dressing of placed fertiliser compared with a double dressing of broadcast fertiliser. They also report that some advantage may be obtained by placing small quantities of superphosphate beneath the seed of some small legumes. Vincent (1954) has stressed the importance of avoiding contact between the inoculated seed and the acid phosphate in the drill line.

The field experiment discussed in this paper was designed to explore the effect of fertiliser placement on the nodulation of subterranean clover. The object of separating the seed and fertiliser was to investigate the possibility of altering the design of seeding tynes to obviate the necessity to mix superphosphate with neutralizing agents.

## Experimental

Preliminary observations in 1953 in intensive drill seedings on a prepared seed bed showed difficulties in nodulation in a red loam, pH 4.8, developed from latite at Berry (Table I).

TABLE I.

*The percentage effective nodulation of Mount Barker and Tallarook subterranean clover plants from inoculated seeds broadcast separately to the drilled superphosphate.*

| % Plants Effectively Nodulated | Mo. Superphosphate Combine Drilled at 3 cwt/acre Inoculated Seed Broadcast | |
|---|---|---|
| | Lime Broadcast 5 cwt/acre | No Lime |
| In Drill Line | 85 | 60 |
| Between Drills | 60 | 15 |

Apparently somewhat satisfactory nodulation can be anticipated without lime providing the inoculated seed was separated from the superphosphate and sown close to the band.

In 1955 a site was selected at Grafton Experiment Farm which appeared to be devoid of strains of *Rhizobium sp.* effective on subterranean clover. The average pH was 5.2 and the soil is described as an amphi-podzolic of mixed volcanic and sedimentary origin. Following cultivation these treatments were established in a replicated randomised block:

(1) Fertilizer 2 inches to the side of seed.
(2) Fertilizer on top of seed, seed drilled ½ inch below.
(3) Fertilizer 2 inches below seed.
(4) Fertilizer sown in contact with seed.
(5) No inoculum with fertilizer in contact.
(6) No fertilizer with no inoculum.
(7) No fertilizer but with inoculum.

Treatments (1) to (5) inclusive were split plot to molybdenised superphosphate, pH 3.5, and molybdenised basic superphosphate, 1 part hydrated lime : 3 parts molybdenised superphosphate pH 13. The fertilizer level used was 428 lb per acre. Each sub-plot consisted of 3 rows each 33 ft long with 12 inches between the drills. Clare subterranean clover seed was inoculated at five times the recommended commercial level with fresh agar cultures of strains SU298 and NA30. The seed was sown immediately with ideal soil moisture conditions.

## Results

Good germination and seedling establishment were recorded for all plots and sub-plots. Following observation samples of 100 random plants were selected from each centre row of each sub-plot twelve weeks from planting. Each plant was carefully removed, washed and weighed. Nodule counts, nodule distribution and size were recorded.

### (*a*) *Percentage of Plants Effectively Nodulated*

Marked differences were observed in the field. The non-effectively nodulated plants were yellow in colour with red pigmentation of the stems and petioles, whereas effectively nodulated plants were green and well-developed. In the grading for effective nodulation, leaf colour, growth and disposition and size of nodules were correlated prior to removal of the roots at the transition node. Serological tests revealed that the nodules which appeared most effective were due to the applied inoculum whilst the small, ineffective types were apparently due to native rhizobia.

TABLE II.

*Mean percentage of plants effectively nodulated (angles in brackets).*

| Treatment | Placement | | | |
|---|---|---|---|---|
| | 2″ Side | On Top | 2″ Below | Contact |
| Super. | 88% (70) | 74% (59) | 93% (75) | 21% (20) |
| Basic super. | 85% (67) | 81% (64) | 86% (68) | 33% (35) |

S.E. of difference between two means in the same column = ± 2.6 deg.

S.E. of difference between two means in same row = ± 7.1 deg.

Where no inoculum was applied no effective nodulation was recorded but the presence of ineffective nodules was noticed. However, where inoculum was applied to the seed and no fertilizer was included in the drill line 75% effective nodulation occurred. In the treatments where the fertilizer was placed 2 inches below the seed the percentage of plants effectively nodulated was significantly higher for molybdenised superphosphate than for basic superphosphate (Table II). With contact sowing the percentage of plants effectively nodulated was significantly lower for acid fertilizer (21%) than for basic fertilizer (33%). Where the fertilizers were placed to the side or on top there were no significant differences. It can be readily seen that contact with acid or very basic fertilizer results in lowered percentages of effectively nodulated plants.

It was observed that effective nodules were positioned on the clover plants approximately alongside the fertilizer band except in the instance of no fertilizer application. In the contact sown plots there

was a significantly higher proportion of nodules in a scattered distribution on the roots; the other treatments showed for a greater part location of nodules adjacent to the tap root or in the case of side placement to a position approximating that of the fertilizer band.

(*b*) *Yield of Herbage.*

The yield of herbage was affected both by the type of nodulation and the available phosphate (Table III).

TABLE III.

*Mean top weights.*
*Gms per* 100 *plants.*

| Placement | Treatment | | | | |
|---|---|---|---|---|---|
| | 2" Side | On Top | 2" Below | Contact | Contact No Inoculum |
| Super | 131 | 127 | 168 | 102 | 111 |
| Basic super. | 125 | 132 | 134 | 125 | 106 |

S.E. difference between two means in same column = ± 7.1 gms.
S.E. difference between two means in same row = ± 10.8 gms.

The interaction between the form of superphosphate and placement was significant. When fertilizer placement was 2 inches below the seed the mean top weight for superphosphate (168 gms) was significantly higher than for basic superphosphate (134 gms), whilst with contact sowing the mean top weight for superphosphate (102 gms) was significantly lower than for basic superphosphate (125 gms). The highest top weight was obtained with superphosphate placed 2 inches below the seed. Where no fertilizer was used with the inoculated seed the mean top weight was 102 gms.

TABLE IV.

*Mean root weights.*
*Gms per* 100 *plants.*

| Treatment | Placement | | | | |
|---|---|---|---|---|---|
| | 2" Side | On Top | 2" Below | Contact | Contact No Inoculum |
| Super | 43 | 51 | 68 | 43 | 51 |
| Basic super | 49 | 49 | 56 | 54 | 49 |

S.E. difference between two means in same column = ± 2.7 gms.
S.E. difference between two means in same row = ± 4.9 gms.

(*c*) *Root Weights*

Again, the interaction between form of superphosphate and placement was significant for the same reasons as those discussed for top weights (Table IV).

The mean root weight recorded from sub plots given no fertilizer but sown with inoculated seed was 36 gms ± 4.9 gms.

## Discussion

Nodulation has been shown to be influenced by a large number of factors and these have been reviewed by Anderson (1949) and Vincent (1954). Some of the more important factors determining successful nodulation are the presence of a competitive effective strain of *Rhizobium sp.* suited to the host plant and the reaction of the micro environment proximal to the seedling. Observations have shown that successful nodulation of Mount Barker and Tallarook subterranean clover plants on an acid red loam may be obtained where superphosphate in the absence of lime was placed beneath the inoculated seed. However, Anderson and Spencer (1948) indicated that the nodulation problem occurred on sites with pH 4.0 and 5.4 respectively. At no centre was nodulation induced by superphosphate, molybdenum, potash, copper, zinc, manganese, iron, boron or magnesium. Again Anderson and Moye (1952) stated that defective nodulation may occur where the soil pH is less than 5.5. A similar field experience was related by McLachlan (1953). Nevertheless, good nodulation was recorded on the acid soil at Grafton, pH 5.2 with band placement of the acid fertilizer. Where no inoculum was applied to the seed effective nodu-

lation on 75% of the plants was recorded where no fertilizer was applied. Also the significant increase in nodulation with band placement suggests that superphosphate may have improved nodulation under these conditions.

Vincent and Waters (1954) have emphasized the use of large sized seed inoculants as a method of overcoming difficulties associated with the occurrence of a large population of native competitive strains. By using large size inoculums Spencer (1950) referred by Anderson (1949) found that the amount and concentration of inoculum used had markedly improved the percentage nodulation of subterranean clover plants. It appears that the size of the inoculum was a determining factor in the effective nodulation of the subterranean clover plants. Again it is emphasised that only five times the recommended commercial level was applied at seed inoculation.

The poor percentage nodulation of the contact sown treatment reflects the lethal effect of low and high pH on the survival of seed inoculum. Evidently, either form of fertilizer is unsatisfactory when sown in contact with the inoculated seed. The use of a neutralized fertilizer treatment would have given more conclusive information with regard to nodulation in this experiment but then again the nodulation counts which were obtained with band placement of acid or basic materials are regarded as satisfactory.

Reversion of the water soluble fraction of the superphosphate to citrate soluble by increasing the pH to 13 has lowered yields. Cradock (unpublished data, 1955) has intimated that hydrated lime may not be a satisfactory neutralizing agency because of the low tolerance in the mixture error.

However, further experiments may indicate successful establishment of clovers without the need for neutrality in the fertilizer mix for drill sowings. Drill tynes may be modified to place fertilizer separately from the inoculated seed. This introduces the problem of soil flow where drilling is desired into the sod. An alternative suggestion is that in the use of a combine with a small seed box or pasture seed box attachment, the cereal box may be modified to allow flow of superphosphate, the normal fertilizer box to be used for agricultural lime, and the pasture seed box for inoculated clover seed, ensuring the placement of the inoculated clover seed in contact with lime. Good nodulation has been recorded in all field trials on acid soils where inoculated clover seeds have been seeded in contact with agricultural lime.

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J. STRANG.

Department of Agriculture,
Berry, N.S.W.

G. WILSON.

Department of Agriculture,
Grafton, N.S.W.

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# A RAPID METHOD OF SAMPLING SMALL FREE-LIVING PASTURE INSECTS AND MITES

The evaluation of insecticide treatments for the control of the Red-legged Earth Mite (*Halotydeus destructor* (Tuck)) and the Lucerne Flea (*Sminthurus viridis* (L.)) in pastures in Western Australia has involved the taking of large numbers of samples. These pests may reach very great densities—sometimes more than 1,000 per square link—and it has been found necessary to develop sampling methods which combine a reasonably high degree of accuracy with rapid collection and counting. During the course of several years' work on these pests a technique, based on that used by Norris (1938), has been developed which reduces collection time to a minimum and enables the otherwise tedious operation of counting to be carried out with reasonable ease and rapidity.

The apparatus (Figures 1-3) consists of the following: (1) A sampling cylinder; (2) a funnel and stand; (3) a box containing a series of sample tubes; (4) a counting tray, and (5) an aspirator with venturi assembly. The sampling cylinder is made of 18 gauge galvanised iron, and is four inches in diameter with a loose fitting metal lid. The bottom edge is sharpened to facilitate pressing into the ground, cutting roots, etc. The metal funnel is six inches in diameter with a piece of fly-wire gauze stretched across inside and supported on a ledge upon which the sampling cylinder is placed. The funnel is held in a wooden frame and as required one of the sample tubes is placed over the neck of the funnel and held in place by a small rubber collar. This collar has parallel sides facilitating the attachment and removal of the tube but ensuring a firm fit. The sample tubes are plastic with the press-on type of cap which can be removed or replaced with much greater speed than the screw-on type. Also these plastic tubes are much more robust than glass ones and are ideal for field work although care must be taken not to expose them to too much heat or to contact with petrol and similar solvents. Ethyl alcohol does not, however, affect them, so samples may be stored in spirit if necessary. These tubes are stored in specially made

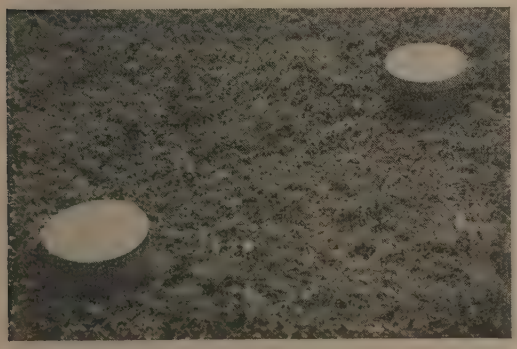

Figure 1.
Sampling cylinders in position in a subterranean clover pasture.

Figure 2.
Funnel and storage box complete with sample tubes. Photo shows collection being transferred from the sampling cylinder to sample tube.

Figure 3.
Counting tray and aspirator in use.

boxes designed to preserve the order of the tubes according to the lay-out of the experimental plots being sampled.

The counting trays are simply metal dishes about 12 in. x 8 in. and about 2 in. deep, painted a colour which aids the detection of the organisms being counted. A dark blue or chocolate colour has been found most suitable for the earth mite and lucerne flea samples.

The aspirator is made of $\frac{3}{8}$ in. copper tubing and is of the normal T-type venturi fitted with a small trigger mechanism, a one-inch diameter receiving tube and 3 mm bore pick up tube. It is operated at a pressure of approximately 35 lb per square inch from a portable compressor.

When sampling, the cylinder is simply pressed into the ground to a depth of about two inches and then lifted with the enclosed core of soil and pasture. The lid is removed and the cylinder quickly inverted over the funnel, a sample tube having been placed over the neck of the funnel beforehand. The sides of the cylinder are then knocked 10-20 times with a suitable "club", the cylinder being rotated as this is done. The sample tube is then removed, the cap quickly replaced, and the tube returned to the storage boxes. When a box is filled with samples it is taken back to the utility truck—fitted with built-in work bench—and the organisms in the tubes are then gradually scattered over the counting trays and counted by means of the aspirator.

Using this method up to 100 samples can be collected by one person in less than an hour. The time varies according to the condition of the soil, hard and dry soils requiring more time than damp soils. Generally this method is not suitable for dry and very sandy soils as it is very difficult to remove an intact sample and too much soil falls through the funnel into the sample tube when the cylinder is inverted. However, it has been satisfactory for all soils encountered in the present work during the winter months when the surface is moist and there is a reasonable cover of plant material.

Careful examination has shown that very few individuals are left behind in the collecting cylinder after the knocking procedure even when the pasture is quite wet following rain. Usually the recovery appears to be virtually 100 per cent. and it is doubtful if the losses ever amount to more than one or two individuals.


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M. M. H. WALLACE.
Division of Entomology.
C.S.I.R.O., Nedlands, W.A.



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# VARIETAL SUSCEPTIBILITY, CONTROL AND SEASONAL INCIDENCE OF RASPBERRY LEAF RUST IN TASMANIA

## Introduction

Leaf rust of raspberries in Tasmania is caused by an autoecious rust fungus (*Phragmidium rubi-idaei* (D.C.) Karst.) which produces yellow-orange aecidia on the upper surface of the leaves in late October and early November. Orange-yellow uredosori later appear on the lower surface of the leaves and the dark brown or black teleutospores are produced in the autumn. The over-wintered teleutospores germinate to produce basidiospores which initiate aecidial infection in the following season.

The 1955-56 season was remarkable for the very high incidence of the disease in the main raspberry growing areas of Tasmania. Lloyd George is the most susceptible of the commonly grown varieties, the normal level of infection being in the order of one or two aecidia on 5 to 10% of the lower leaves. In 1955-56 in badly affected plantations of Lloyd George all the lower leaves were infected, 100-200 aecidia and later up to 2,000 uredosori being present on individual leaflets. Aecidia also commonly occurred on the calyx. During the aecidial stage of infection the yellowish-orange colour of the foliage could be seen from a distance of several chains.

There was an abnormally high rainfall in the weeks prior to and during harvest and observations suggest that there was very little loss in yield. There was, however, a certain amount of premature defoliation in heavily infected patches and there is little doubt that had the season been dry, heavy losses would have occurred in these areas.

## Varietal Susceptibility

Observations on varietal susceptibility were made at the Summerlea Horticultural Research Station on a Latin Square block of seven varieties. A rating system in which leaves were graded from 0 to 3 according to severity of infection was used to obtain a measure of the degree of infection when the fungus was in the uredospore stage and the results are presented in Table I.

TABLE I.
*Varietal susceptibility to Raspberry leaf rust.*

| Variety | Infection Rating |
|---|---|
| | % |
| Lloyd George .... .... .... .... | 33 |
| Neika .... .... .... .... .... .... | 31 |
| Collins' Defiant .... .... .... | 1 |
| Norfolk Giant .... .... .... .... | 1 |
| Red Antwerp .... .... .... .... | 0 |
| Fillbasket .... .... .... .... .... | 0 |
| Taylor .... .... .... .... .... .... | 0 |

L.S.D. 1% = 7.7
Date of Sampling—6/1/56.

These results show that Lloyd George and its seedling Neika are very susceptible, while on the other varieties infection was negligible. A few uredosori were noticed on Red Antwerp, Fillbasket and Taylor, although none occurred in the leaf samples rated for infection. White (1946) remarks on the noticeable susceptibility of Fillbasket but Lloyd George and Neika were not grown extensively in commercial areas at that time.

## Fungicidal Control

The effects of fungicides on rust infection were assessed in a spraying trial on the variety Lloyd George. The results were obtained by the same method as that used in the Varietal Susceptibility trial and are set out in Table II.

TABLE II.

*Raspberry leaf rust control—spray schedules and results 1955-56.*

| Treatment | Green Tip 29/9/55 | White Bud 3/11/55 | Leaf Rust Infection Rating % |
|---|---|---|---|
| A | 6.4.40 Bordeaux | 3.2.40 Bordeaux | 16.7 |
| B | 6.4.40 Bordeaux | 3.2.40 Bordeaux | 15.0 |
| C | — | 3.2.40 Bordeaux | 24.9 |
| D | Thiram | Thiram | 24.1 |
| E | Captan | Captan | 27.2 |
| F | Ferbam | Ferbam | 30.9 |
| G | Unsprayed Control | | 47.6 |

L.S.D. 5% = 7.6.
L.S.D. 1% = 10.2.

Rates of Application:

Thiram (T.M.T.D.) .. .. .. 1½ lbs/100 gal.
Captan (S.R. 406) .. .. .. .. 2 lbs/100 gal.
Ferbam (Fermate) .. .. .. .. 2 lbs/100 gal.

Note:

At the time of sampling (26/1/56) A and B had had identical treatment since the post-harvest spray had not been applied.

The most effective control of the disease was obtained with two Bordeaux sprays, one at the green tip stage and one at the white bud stage. Control was not as good when Bordeaux mixture was applied at the white bud stage only. The effect of the green tip spray in reducing the infection with uredosori may be due mainly to a reduction in the load of aeciospores on the plant or to a residual fungicidal effect. The number of aecidia on the unsprayed control bushes was noticeably greater than on those which had been sprayed at the green tip stage, but no detailed record of aecidial infection was made. Captan, Thiram and Ferbam also gave significant control of leaf rust but were inferior to Bordeaux mixture. These results generally confirm those obtained in the previous year (Geard 1955) although significant control was not obtained with Captan and Thiram in that season, the incidence of the disease being very much less.

### Seasonal Incidence

The incidence of the disease was remarkably high in 1955-56, and an attempt was made to determine the cause of this high incidence. It seemed unlikely that the outbreak was due to the appearance of a new race of the parasite since the heavy infection was general throughout the raspberry growing areas and showed no signs of having originated in a particular locality. It appeared more likely that the outbreak could be accounted for by favourable weather conditions at a critical period.

The heavy infection with the aecidial stage of the fungus became evident in the last week of October, indicating that infection had taken place in the first weeks of that month. Therefore the weather records for October (taken at Hobart, the station nearest to the main area of production) were examined and compared for the period 1943-55. A continuous record of the occurrence of plant diseases in Tasmania is available only since 1943 and this year was therefore selected as the starting point for the examination. The striking feature revealed by this examination is the fact that during the 72 hour period 7th to 9th (inclusive) of October, 1955, the relative humidity did not fall below 87% (hourly readings range 87-99%; average 95%) and the temperature did not fall below 10.5°C (hourly readings range 10.5-15°C; average 12°C). The details of this and all other similar periods of high average humidity in October since 1943 are set out in Table III.

The humidity conditions required for the establishment of many fungus diseases have been studied in detail, and in general it is found that high humidities are favourable to infection. Infection with cereal rusts usually requires a humidity above 92-93% (Butler & Jones 1949). Brizgalova (1937—quoted by Chester 1946) found that teleutospores of *Puccinia triticina* produces basidia in 9 hours at 6-19°C. There appears to be no detailed information available on conditions favouring infection of the alternate host (*Isopyrum fumarioides*) from basidiospores but it seems reasonable to assume that high humidity and temperatures in the range of 6-19°C would favour the process.

The data given in Table III show that conditions of temperature and humidity during the period 7th-9th October, 1955,

TABLE III.

*Temperature and humidity records for extended periods of high average humidity in October since 1943 (Hobart).*

| Period | | Relative Humidity % Hourly Readings | | | Temperature (°C.) Hourly Readings | | |
|---|---|---|---|---|---|---|---|
| Date | Duration (hrs) | Av. | Min. | Max. | Av. | Min. | Max. |
| Sept. 30-Oct. 2, 1944 | 69 | 89 | 63 | 100 | 9.0 | 5.0 | 14.0 |
| Oct. 24-27, 1945 .. .... | 78 | 84 | 62 | 99 | 13.0 | 10.5 | 19.0 |
| Oct. 7-9, 1947 .... .... | 72 | 85 | 51 | 99 | 10.5 | 6.5 | 16.0 |
| Oct. 29-31, 1947 .. .... | 72 | 89 | 71 | 100 | 10.5 | 7.0 | 19.0 |
| Oct. 2-4, 1949 .... .... | 72 | 88 | 61 | 97 | 11.0 | 7.0 | 16.0 |
| Oct. 25-27, 1950 .. .... | 72 | 87 | 58 | 98 | 15.0 | 11.0 | 21.0 |
| Oct. 12-14, 1951 .. .... | 72 | 86 | 58 | 97 | 14.0 | 11.0 | 20.0 |
| Oct. 10-14, 1952 .. .... | 72 | 81 | 57 | 92 | 9.5 | 5.0 | 15.0 |
| Oct. 7-9, 1955 .... .... | 72 | 95 | 87 | 99 | 12.0 | 10.5 | 15.0 |

were much more likely to favour infection of raspberries with basidiospores of raspberry rust than on any other occasion in October since 1943. The minimum humidity recording for the three day period was 87% whereas of the other periods of high humidity detailed none had a minimum above 71%. The minimum temperature was 10.5°C and the average 13°C. These favourable conditions probably contributed largely to the severity of infection with raspberry rust in the 1955-56 season.

The records also deserve some consideration in the light of White's (1946) record that rust infection badly affected crops in 1944, although it is evident from Table III that humidity and temperature conditions in October were not as favourable to infection in that year as they were in 1955. The reports of growers make it clear that the outbreak of 1944 was not as severe as that of 1955 and few recalled having noticed the aecidial stage of the fungus before the latter year. Further, during the years 1945-54 there were seven periods in October with an average humidity comparable to that of 1944 but severe rust infection was not recorded. This is not unexpected since many other factors may affect the establishment of the aecidial stage. These factors would include the minimum humidity and temperature during the period of high average humidity and the timing of this period in relation to the critical stage of teleutospore maturation (for example, periods detailed in 1945, 1947 and 1950 may have been too late to affect establishment of the aecidial stage from basidiospores). Factors affecting the production and establishment of aeciospores and the production and further infection with uredospores must also be more or less favourable for the eventual build-up of a serious degree of rust infection.

Other potentially important factors about which nothing appears to be known for this species are those which affect the over-winter maturation of teleutospores (if this process is necessary) and which would determine the initial load of basidiospores. Eriksson (1924) found that teleutospores of *P. subcorticium* would only produce infection after having been exposed to the rigours of winter.

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Thanks are due to Mr. H. K. Fenton, Manager of the property on which the spraying trial was conducted.

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IAN D. GEARD.

Plant Pathology Division,

Department of Agriculture,

Hobart, Tasmania.



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# THE REACTION OF SUBTERRANEAN CLOVER VARIETIES TO SCORCH CAUSED BY *KABATIELLA CAULIVORA* (KIRCHN.) KARAK.

## Introduction

Subterranean clover (*Trifolium subterraneum* L.) is one of the most important Australian pasture plants and work in recent years has shown that it is attacked by a number of diseases, such as rust and various virus infections, which reduce its grazing value. They do not usually, however, kill out large numbers of plants.

During November, 1955, subterranean clover in the Berrigan Irrigation area of New South Wales was attacked by a severe disease. Several hundred acres were affected, the disease varying in severity from lightly affected areas to those showing a 90% reduction in yield. In some places, a complete loss of grazing resulted and seed setting was considerably reduced. The main variety attacked was Bacchus Marsh but the disease was also seen on Mount Barker. Growers indicated that it had been observed to a lesser extent in the 1954 season.

Examination of affected plants showed that the disease was that known on clovers in Europe and America as northern anthracnose or scorch and caused by the fungus *Kabatiella caulivora* (Kirchn.) Karak. This disease had not previously been recorded in Australia and, as far as can be determined, had never been described on *Trifolium subterraneum*. Overseas red clover (*T. pratense* L.) is the main one attacked (Sampson 1928). Symptoms of the disease in New South Wales have been described elsewhere (Walker 1956) and briefly consist of elongated sunken lesions on petioles and stems, causing leaves to hang down and wither, giving the pasture a scorched appearance.

In view of the importance of the disease on clovers overseas and of subterranean clover in Australian pasture work, a large number of subterranean clover varieties were tested by artificial inoculation with the Australian isolate of *Kabatiella*. Other species of *Trifolium* were also included in the tests. Some preliminary results are now available and are published in this note.

## Method

Plants for inoculation were grown from seed in 4-inch pots, about 30 seeds being planted per pot. They were spray inoculated with a spore suspension of the

fungus one month after planting, most plants having 2-4 trifoliate leaves at the time of inoculation.

Inoculum was prepared on pieces of autoclaved bean pod 2-2½ inches long placed in test-tubes with about ½ inch of water. Young colonies of the fungus on potato dextrose agar were streaked over the surface of the bean pod pieces and these incubated at 18-20°C. After 4-5 days the slimy creamy pink growth of fungus consisting of a mass of budding spores had covered the surface of the bean pod pieces. This was washed off into tap water and sprayed onto the clover plants.

After inoculation, plants were kept in a moist chamber for 48 hours and were then placed in a cool position outside the glasshouse. The temperature during this period varied from 58°F. to 90°F. being mainly in the range from 60°F. to 85°F.

Results were taken twelve days after inoculation and on the basis of the reactions observed, the plants were classified into four groups as follows:—

*Severely affected*—majority of leaves with severe petiole lesions; whole plant eventually killed.

*Moderately affected*—some leaves with severe petiole lesions and several killed. Whole plant not killed.

*Slightly affected*—few leaves showing petiole lesions: a few bent over and dying.

*Not affected*—no lesions seen.

Two pots of clover plants, classed as "slightly" and "severely affected" respectively are shown in Figure 1.

## Results

The inoculation results are summarised in Table I and it is seen that, with the exception of two lines of *T. subterraneum* (varieties Mulwala and Wallace), all the

TABLE I.

*Reactions of species of Trifolium and varieties of T. subterraneum to inoculation with Kabatiella caulivora.*

| Severe | Moderate | Slight | No infection noted |
|---|---|---|---|
| *T. incarnatum* *1 | *T. incarnatum* 2 | *T. alexandrinum* 1 | *T. subterraneum* var. |
| *T. subterraneum* var. | *T. subterraneum* var. | *T. dubium* 1 | Mulwala S12 |
| Bacchus Marsh S4 | Dwalganup S8 | *T. pratense* 1 | Wallace S23 |
| Lake Widgeon S9 | Merino S10 | *T. pratense* 2 | |
| Mount Barker S3 | Pearson S15 | *T. repens* 1 | |
| Mount Barker S11 | Williams S19 | *T. subterraneum* var. | |
| Tallarook S2 | | Bass S5 | |
| | | Clare S6 | |
| | | Cranmore S7 | |
| | | Dwalganup S1 | |
| | | Kyhybolite S24 | |
| | | Muresk S13 | |
| | | Oxford S14 | |
| | | Romsey S16 | |
| | | Ruakura Sel$^{n}$. S21 | |
| | | Smeaton S22 | |
| | | Springhurst S17 | |
| | | Tallarook S18 | |
| | | Yarloop S20 | |

*The number after the name is the accession number of the seed line in the author's collection.

Figure 1.
Left—Dwalganup (S1) slightly attacked. Note bending of leaflet on extreme left due to petiole lesion. Right—Mount Barker (S3) severely attacked.

clovers tested were attacked in some degree.

The varieties affected in the field, Bacchus Marsh and Mount Barker, were severely attacked and the two lines of the latter reacted similarly in this regard. This was not the case with two lines of Tallarook in which one (S2) was severely affected whilst the other (S18) was only slightly attacked. The other fully susceptible variety was Lake Widgeon.

Of the other subterranean clover varieties, the majority were only slightly affected and two, Mulwala (S12) and Wallace (S23) were not affected at all.

Of the other species of *Trifolium*, crimson clover (*T. incarnatum* L.) was the most severely affected, the others being only slightly attacked.

## Discussion

In the results quoted above, it can be seen that all the species of *Trifolium* tested were attacked to some extent. Sampson (1928, 1954) was able to obtain infection only on red, alsike (*T. hybridum* L.), shaftal (*T. suaveolens* Willd., now *T. resupinatum* L.) and white (*T. repens* L.) clovers, only a few leaves of the last being attacked. In the present tests also, white clover was only slightly attacked. With red clover, Sampson found that varieties from various sources varied considerably in their reaction to this disease, the early flowering strains being generally the more susceptible. Both strains of red clover used in the present tests were only slightly attacked.

Crimson clover was, with some varieties of subterranean clover, the most susceptible species in the present tests. Sampson was not able to infect this species, but Wellensiek (1926) in Holland was able to infect it and it is attacked in the field in the United States (Weiss 1952). In the present tests infection was also recorded on berseem (*T. alexandrinum* L.) and yellow suckling (*T. dubium* Sibth.) clovers. No record of infection on these two species has been seen in the literature.

The subterranean clover varieties tested show considerable differences in reaction between varieties and, as illustrated by the variety Tallarook, lines of the same named variety from different sources may react differently. It is thus not possible to generalise about the behaviour of a variety towards the disease and the above results do not indicate that all lines of the varieties listed will react in the manner shown. It is interesting to note, however, that the variety Mulwala, the line of which tested here was not attacked, is listed by Latter (1952) as immune to two races of rust (*Uromyces trifolii subterranei*). This variety, in addition to its value as a parent in breeding for rust resistance, may also be of similar value against *K. caulivora* if the disease becomes severe.

At the present time seed of several other lines and varieties of subterranean clover and of other species of *Trifolium* (kindly made available by the C.S.I.R.O. Division of Plant Industry and the various State Departments of Agriculture) is on hand for testing with *K. caulivora*. Results will be published when this work is completed.

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ties used in the above work is gratefully acknowledged.


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J. WALKER.

Department of Agriculture,
Sydney.

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# *CYLINDROCARPON RADICICOLA* WR.: THE RECORDING OF A NEW FUNGUS ON GRAPES IN VICTORIA

Severe shedding of Ohanez grape berries occurred in the Mid Murray area of Victoria in December, 1955. At the time of shedding, small black necrotic spots were seen to be scattered over the pedicels and blossom ends of the berries. These spots varied from 1/32 inch-1/16 inch in diameter and were level or slightly raised above the berry surface.

A fungus was consistently isolated from the infected tissue. As Ohanez grapes were not available for pathogenicity tests, the variety Gordo Blanco was used. These tests showed that this fungus would rapidly invade green berries only if the skin was first ruptured (Fig. 1). A second series of tests carried out eight weeks later when the grapes were beginning to ripen, showed that the organism invaded more mature berries with difficulty, only a few weak infections being recorded. In both series

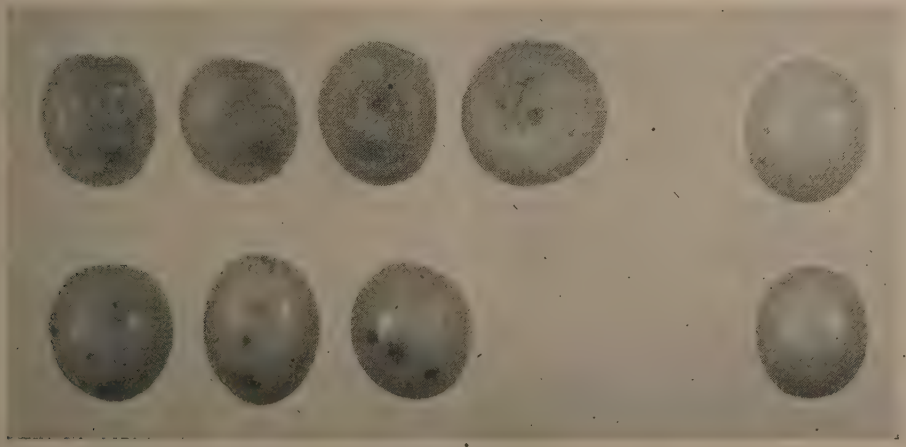

Figure 1.
C. radicicola invading injured Gordo Blanco berries. Top: 4 days after inoculation. Lower: 2 days after inoculation. Uninoculated controls on right.

of tests, the fungus was recovered in all cases where infection occurred.

The fungus was identified by Dr. W. Gordon of the University of Manitoba, Canada, as *Cylindrocarpon radicicola* Wr. This is believed to be the first time it has been recorded on grapes.

As *C. radicicola* has been shown to be pathogenic only if the skin of the berry is broken, it is not considered to be a primary factor in the shedding of Ohanez berries, but rather to be a secondary organism which invades tissue already weakened by another cause; in this case, probably the unfavourable weather which occurred in 1955 about the time of setting. This is in accord with the opinion of other workers. Gram & Weber (1951) who record this fungus on a range of hosts, state that it is a widespread soil organism which will invade the roots and above ground parts of plants already weakened by some other factor.


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R. H. TAYLOR.

Biology Branch,
Department of Agriculture,
Victoria.



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# CYTOLOGICAL EVIDENCE FOR APOMIXIS IN AUSTRALIAN *PASPALUM DILATATUM*

*Paspalum dilatatum* Poir. is a widely grown pasture grass in Australia. The development of improved strains of this species depends upon genetic variation being available. Superficial observation of a number of collections of Australian commercial material revealed a surprising lack of variation in a plant which has features indicative of cross-pollination. This suggested that the species may have an apomictic breeding system. As part of an investigation to examine this possibility, a cytological examination was made of meiosis in the pollen mother cells of Queensland commercial material obtained from the C.S.I.R.O. Plant and Soils Laboratory in Brisbane, and of plants growing near the C.S.I.R.O. laboratories at Canberra.

The nine plants examined had a diploid chromosome number of 2n = 50. This number has been reported previously for *P. dilatatum* (Krishnaswami 1940; Tateoka 1955) from root tip counts. At metaphase I the majority of the pollen mother cells contain 20 bivalents and 10 univalents, and there are some cells with 19 bivalents and 12 univalents. The small size of the chromosomes prevented accurate determination of the chiasma frequency, but usually there appear to be two chiasmata per bivalent. The univalents lag and divide at anaphase I, and an occasional micronucleus is seen at telophase I. More micronuclei are seen at telophase II. Although about 60% stainable and presumably functional pollen is found in the anthers, the constancy of the chromosome number and chromosome behaviour in plants from different areas suggests that reproduction is apomictic.

Barnard (private communication) has found evidence of multiple embryo sacs, and of zygote formation prior to fertilisation in Australian *Paspalum dilatatum*. These features support the chromosomal indication of apomixis.

Other reports of meiosis in *Paspalum dilatatum* describe material in which 2n = 40 (Burton 1940; Forbes 1955).

It is probable that the taxonomy of the genus, as that of most apomictic groups, is very complex. Hence, accounts of overseas work with *P. dilatatum* may not always refer to the material of that name in Australia.

Apomixis prevents immediate improvement in Australian *P. dilatatum*. However the chromosome behaviour in this material suggests a hybrid origin. The relationship between hybridity and apomixis, may enable apomixis to be turned to advantage, or to be overcome. The basic chromosome number of the genus is 10, and presumably the genome formula of the Australian material is AABBC. Combined cytological and taxonomic studies may identify sexual or partially apomictic plants with the genome formulae AABB and AABBCC and CC. Resynthesis of the AABBC type would then be possible by the hybridisation in one instance and by obtaining an unreduced gamete of AABB and subsequent hybridisation with CC in the other instance. It is unlikely that all the resultant hybrids from crossing different strains of these genome types will be apomictic. A range of variability should thus be available for selection, with the possibility of using apomixis to fix promising material.


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D. L. HAYMAN.

Division of Plant Industry,
C.S.I.R.O.,
Canberra, A.C.T.



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# BROWN ROT OF STONE FRUITS IV. ON THE PEACH IN WET AND DRY WEATHER AT HARVEST-TIME IN 1956*


**Summary**

Very significant differences between the percentages of brown rot on light and heavy soil types were observed in the Shepparton area for the third successive year. They were associated this season with three inches of rain a week before maturity of the early peach, but with only 40 points of rain before maturity of mid-season varieties. These findings and their implications are discussed.


## Introduction

The investigations reported by Angell (1955a, b) on the relation of soil type to destructiveness of brown rot *Sclerotinia fructicola* (Wint) Rehm of peach, *Prunus persica* Batsch. were continued in the 1956 season. Three inches of rain fell a week before the first Levis Cling peaches were ready for delivery to the cannery. When the Phillip's Cling were at the same stage of development, three weeks later, only 40 points of rain fell, the temperature being above 100°F. If, as suggested by Wade (1952), the stage of maturity is the main determining factor in brown rot attack, either the Phillip's Cling or the still later variety Golden Queen should presumably have escaped destruction. Crop losses of Levis Cling in several orchards on deep phases of sandy loams exceeded the quantities of marketable fruit, but the losses on loams were small. The losses of Phillip's Cling and Golden Queens on light soils in some orchards were reported to amount to about half the crop. These estimates were made while the skin of the Golden Queen which as the name implies, is yellow at maturity, was still green.

## Observations and Results

Considerable differences within plantings of Levis Cling were observed by the writer in seven orchards, but the numbers of rotting and healthy fruit could be counted in only five of them in the in-

*By arrangement the writer's work on brown rot in this area is limited to observation only.

terval between discovery and picking for market. Differences within plantings of Golden Queen and Phillip's Cling were discovered and counted in six orchards. Diseased and healthy fruit of both varieties were counted on 5 to 8 trees in plantings on two contrasting soil types in each orchard. The branches taken on the separate trees were determined by a prior decision. The numbers of diseased and healthy fruit were recorded and it was clear from inspection that the variation in the percentage of diseased fruit varied from tree to tree greatly in excess of pure chance. In getting an aggregate figure for the planting on the particular soil type it was considered fairest to determine the percentage of diseased fruits for each branch and to average these percentages. The percentages were not correlated with the number of fruit. Differences in disease percentages within each orchard were associated with soil types and are given in Table I and II. The mean difference between the average percentages (or an appropriate transformation of them) of diseased fruit on the two soil types, taken over the five plantings of Levis Cling is significant at $P < .001$ and six plantings of the other varieties, at $P < .01$.

TABLE I.

*Average percentages of diseased Levis Cling from one branch from five to eight trees on two soil types on each of five orchards.*

| Farm | Lighter soil | Heavier soil | Remarks |
|---|---|---|---|
| 1 | 48.7 | 7.8 | Sandy loam VS Goulburn clay loam |
| 2 | 75.8 | 5.0 | East Shep. Sandy loam VS Shep. loam |
| 3 | 75.3 | 15.8 | Shep. Sandy loam VS Goulburn clay loam |
| 4 | 27.9 | 3.1 | Deep phase Shep. Sandy loam VS Shep. loam |
| 5 | 64.4 | 16.4 | Deep phase E. Shep. Sandy loam VS Shep. Sandy loam |
| Mean | 58.4 | 9.6 | Mean diff. sig. at $P < .001$ |
| Difference | 48.8 | | |

TABLE II.

*Average percentages of diseased peaches from six trees on two soil types on each of six orchards in a dry season.*

| Farm | Lighter soil | Heavier soil | Remarks |
|---|---|---|---|
| 1 | 72.0 | 30.5 | Golden Queen, on deep phase of East Shep. sandy loam and Orrvale loam |
| 2 | 26.8 | 8.9 | Phillip's Cling on deep phase of East Shep. sandy loam and Shepparton loam |
| 3 | 26.7 | 11.1 | Phillip's Cling on Shepparton sandy loam and Goulburn loam |
| 4 | 35.5 | 7.0 | Golden Queen on Broken Sand and Orrvale loam |
| 5 | 65.4 | 42.0 | Phillip's Cling on Broken Sand and Shepparton sandy loam |
| 6 | 33.6 | 17.0 | Phillip's Cling on Orrvale sandy loam and Shepparton loam |
| Mean | 43.1 | 19.4 | Mean difference significant at $P < .01$ |
| Difference | 23.7 | | |

## Discussion

Field observations may sometimes lead to conclusions of doubtful validity unless variables which are likely to affect results are known. Because such variables are sometimes of such a nature as to be unsuspected, field observations are usually regarded only as a preliminary to experimental plantings. Consideration of the factors involved in the establishment and management of the orchards on which the data in this paper were ob-

tained leads to the conclusion that the differences in disease destructiveness in each orchard could have been due to only one variable, soil type. The plantings were usually in rectangular blocks in which small areas of heavier soils intruded. Neither the orchardists, soil scientists, nor the pathologist, whose work during different periods contributed to the results here given, knew beforehand that the plantings would be used in these studies, the results of which confirm and amplify those obtained in two preceding years in other orchards (Angell 1955a, b).

Soil type in relation to fungal diseases is a relatively recent development. Walker (1950) deals with the subject in a paragraph. Brown rot of peach, as it occurs in the Shepparton district is unique in that although it is a disease of aerial parts of the plant, mainly of ripening fruit, the conditioning factor is fundamentally soil type. Furthermore, the influence of soil water or other associated factors, as manifested in these outbreaks, cannot be on the pathogen, because conidia are produced on infected fruit on trees on different soil types and are airborne to distant or adjoining trees which may sometimes be on different soil types.

Many orchards were visited in the search for plantings on two or more soil types. Great differences in maturity between fruit of different orchards were sometimes observed, even though the orchards were on one and the same soil type. In contrast, in each planting dealt with in this paper there were as great differences in maturity within as between each soil type. That this was correct was later confirmed by the fact that when picking was in progress for a market with exacting standards of fruit maturity, it was not limited by soil types. If, as is popularly thought, the stage of fruit maturity is a factor influencing brown rot destructiveness, it is remarkable that throughout the course of the writer's work, rains have never fallen when the fruit on heavy soils was at a stage of maturity conducive to widespread infection.

The orchardists in whose plantings these observations were made performed the usual pruning and spraying operations for the control of brown rot, but with distinctly different results on light and heavy soils. On reference to Table I it will be observed that under conditions which resulted in the destruction of 58 per cent. of fruit on light soils, less than 10 per cent. was destroyed on the heavier soils. In Table II the corresponding figures are 43 per cent. and 19 per cent. Differences of the same order as in Table I were previously recorded (Angell 1955a, b). As the soil type has such a great influence on destructiveness of the disease, and was not recorded until 1955 the necessity for experiments on the efficacy of sprays on different soil types is obvious. However, the relative inefficiency of such means of control on light soils in three seasons in which the trees were waterlogged at ripening time, and in the latest instance three weeks before ripening, suggests that other approaches to the problem of control are necessary. The alternative to the gradual shifting of peach planting to suitable loams is to devise means of avoiding or minimising waterlogging of sandy loams.

It does not follow that the factors influencing brown rot in this area are likely to be the same as in other districts. It would be surprising if it were so because climatic and soil conditions and cultural practices are different in each area. In the non-commercial stone-fruit growing areas of Canberra, in which it was first discovered that the weather at harvest time was not the main environmental factor influencing destructiveness, practically total loss on some trees is sometimes sustained, irrespective of weather conditions. The heavy losses of Phillip's Cling and Golden Queen in Shepparton in a relatively dry picking season may have been a delayed effect of waterlogging

three weeks earlier when the Levis Cling was affected. Other delayed effects of waterlogging can be seen throughout the area. There is no evidence that suggests that brown rot of the peach in Canberra is associated with waterlogging.

Parenthetically it should be noted that these observations deal with brown rot of peach only. This is because it has been observed in Canberra that there may be extreme variation in destructiveness on different species of stone fruits, as for example, nectarines and plums, growing side by side and ripening at the same time. It is suggested therefore that the factors influencing brown rot of species of stone fruits may be different, and that, as the fungus is a common factor, independent of the soil, their differential action is on the host.

These field observations lead to the conclusion that control of brown rot in this area demands the co-operation of soil scientists, physiologists, horticulturists, and pathologists in preventing or minimising the adverse effects of unsuitable soil conditions on the physiology of the tree, and more particularly, on the ripening fruit.


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H. R. ANGELL.

Division of Plant Industry,
C.S.I.R.O.,
Canberra.



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# EELWORM ATTACKS ON VINES IN THE MURRAY VALLEY IRRIGATION AREA.


**Summary**

Diseases of vines caused by four nematode species—*Meloidogyne javanica, Pratylenchus vulnus, Pratylenchus scribneri,* and *Tylenchulus semipenetrans,* are described. Two of these nematodes, *Pratylenchus scribneri* and *Tylenchulus semipenetrans,* have not previously been reported from vines.


## Introduction

Three eelworm species are mentioned in literature as parasites of vines—*Meloidogyne incognita, Meloidogyne javanica,* and *Pratylenchus vulnus.* In the literature on eelworm attack in Australian vines, only root knot is mentioned, without further definition of the species.

During a survey of nematode diseases in the Murray Irrigation Area in the summer of 1954-55, four nematode species were found attacking the roots of vines, each of them probably causing serious damage in at least one case. These nematode species were root knot (*Meloidogyne javanica*), root lesion nematodes (*Pratylenchus vulnus* and *Pratylenchus scribneri*), and citrus nematode (*Tylenchulus semipenetrans*). Two of them, *Pratylenchus scribneri* and *Tylenchulus,* have not been reported as parasites of vines. A short description of the symptoms of all four attacks follows.

## Root Knot

Root knot nematodes seem to be widely spread throughout the Mildura irrigation area where vegetables and weeds such as fat hen and paddy melon are attacked. They were found to be common on vines. Certainly it is not only the Mildura area that is infested. Root knot was also found in Berri and a heavily infested vine was received from Loxton.

In the above-ground parts of perennial plants eelworm attack causes a condition which is very well described by the term

Figure 1.
Nematode infested sultana vine (partly pruned). A healthy vine should show 8 to 10 rods (canes) at this stage of pruning.

"slow decline". The symptoms are the same for attacks by different eelworms. Vines attacked by eelworms, like other perennials, show poor growth (Figure 1). The plants are stunted. Young shoots remain short, and, in the case of severe damage, may be so sparse that the vine

Figure 2.
Vine rootlets (var. Gordo) attacked by root knot (Meloidogyne javanica).

Figure 3.
Vine (var. Riesling) severely attacked by root knot (Meloidogyne javanica).

shows bare arms. There are no specific symptoms which indicate that the vine is attacked by eelworm, indeed, it is the absence of specific symptoms in above-ground parts which suggests eelworm attack as the most probable cause of stunted growth.

The symptoms on the roots differed rather widely in different varieties. The most common symptom was the occurrence of small swellings on strongly branched vine roots (Figure 2). In one case, however, Gordos showed hardly any galls, but many egg masses were protruding from the roots as whitish dots about 0.5 mm in diameter. Adjacent Walthams showed the normal small galls. A Riesling vine from Loxton showed symptoms which were entirely different from those of all other specimens. The fine roots were comparatively lightly infested, but galls of up to an inch in diameter were observed on the tap root and on the thick lateral roots (Figure 3). This may be a varietal characteristic but it is also possible that this plant was attacked

Figure 4.
Vine rootlets (var. Pedro Ximines) attacked by Pratylenchus vulnus.

in a young stage in the nursery, and was later transplanted to uninfested soil.

In cases of very heavy attack, the roots of the vine die to a large extent, and this may kill the entire vine.

In all cases investigated, root knot of vines in the Murray irrigation area was caused by *Meloidogyne javanica* (Treub) Chitwood.

### Root Lesion Nematodes

(a) *Pratylenchus vulnus* Allen and Jensen.

This nematode is a rather important parasite of vines in California (Allen and Jensen 1951). It seems to be widely spread in Australia, where it was found on apples, walnuts, and vines.

The above-ground parts show the same type of poor growth as vines attacked by root knot. Symptoms in the roots are quite different, however. Where *P. vulnus* penetrates into the cortex, small lesions develop. These lesions enlarge rapidly and soon the root is girdled and the part distal to the lesion is killed (Figure 4). There is some extra branching of roots above lesions, but, in contrast to root knot *P. vulnus* causes serious root rot which severely reduces the amount of roots. In cases of heavy attack it is very difficult to find an appreciable amount of feeding roots. Only thick, relatively undamaged roots remain. This makes it rather difficult to find the disease causing organism, which can, moreover, cause extensive damage when present in soil and roots in small numbers.

(b) *Pratylenchus scribneri* Steiner.

This nematode has not previously been reported from vines. Four cases of attack were found. In two of these cases the attack was severe, and almost certainly caused the poor growth of vines, though a slight infestation of root knot was present.

Above-ground symptoms were the same as in all other cases of eelworm attack. The most conspicuous symptom of the root system was extensive root proliferation (Figure 5). The roots did not spread very far, but formed entangled masses of strongly branched roots with many very short lateral rootlets within about two feet of the trunk.

Microscopic examination showed that the lateral roots were covered with small lesions. The root tips were severely damaged in many cases. Comparatively large numbers of eelworms of the species *Pratylenchus scribneri* Steiner (as described by Sher and Allen 1952) were found in the lesions. Only very low num-

Figure 5.
Vine rootlets (var. Sultana) attacked by Pratylenchus scribneri.

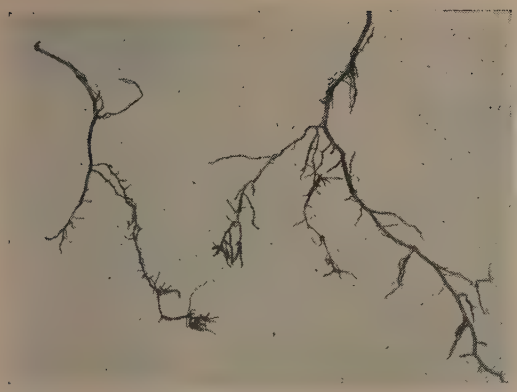

Figure 6.
Vine rootlets (var. Doradillo) attacked by Tylenchulus semipenetrans.

bers of *P. scribneri* were found in the soil around infested roots.

### Citrus Nematode

One of the most striking discoveries of the eelworm survey was the wide distribution of citrus nematode on vines in the Murray irrigation area. *Tylenchulus* was found in almost as many cases as root knot. In one instance it was the only parasitic nematode associated with a poor patch of Doradillos. There was generally no apparent relation between the culture of citrus or olives, the only cultivated hosts of *Tylenchulus* so far reported, and the occurrence of citrus nematode on vines. It occurred even on heavy soils where citrus had never been grown. In most cases examined there was no apparent damage, or there were other possible causes of damage, for example root knot or salt accumulation.

In the above-ground parts of the infested Doradillos, the clearest case of citrus nematode damage to vines which was examined, stunted growth was the only symptom. The roots of infested plants resembled those of infested citrus in many respects. There was some extra branching of roots, but far less than with the attack by *P. scribneri* already described. Soil particles clung very persistently to the roots in many places. As in citrus, they stuck to the gelatinous egg masses which surround the female of the citrus nematode. The infested roots had many irregular bends and sometimes showed extensive necrosis of the bark (Figure 6). As in citrus, the citrus nematode may occur on the vine roots (females) and in the surrounding soil (males and larvae) in enormous numbers.


### Acknowledgment

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J. W. SEINHORST
M. R. SAUER

Commonwealth Research Station,
Merbein, Victoria.



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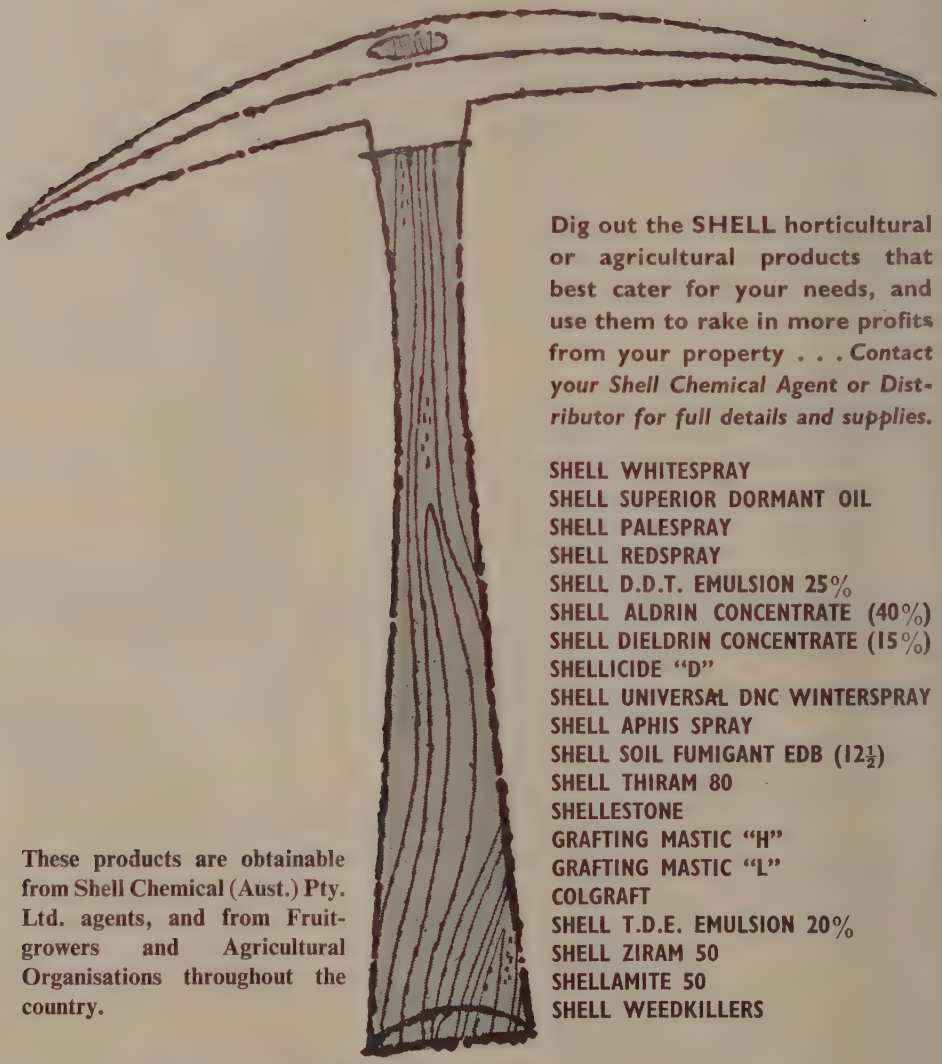

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# TALKS

The following two talks were given to a combined General Meeting of the New South Wales Branches of the Institute of Agricultural Science and the Animal Production Society.

They came under the general heading "Aspects of the Meat Industry."

## The Future of our Export Meat Trade.

*Mr. J. L. Shute, Chairman of the Australian Meat Board.*

In his talk, Mr. Shute suggested that the Australian meat export trade is at the crossroads at the present time and the outcome will depend upon present overseas talks. This is an industry in which it is impossible to predict results. There is, however, an excellent export meat trade provided we can supply grade and classification at the prices demanded by the U.K. market, which is our only reliable market. All other markets are secondary in absorbing our surplus products. We have a great production potential provided certain impediments can be overcome. The problem calls for co-operation between the Government, grower and industrialists—an enormous task of organization.

At present the industry is passing through a difficult transition period after 16 years of control during which surpluses were purchased and distributed in bulk and this, from a trading point of view, was a fairly simple process.

During the war Australia made a stupendous effort for meat production and there was no difficulty of disposal. Australia entered into agreements of sale where margins of profit were reasonable. The "Good quality producers" (South American combines) curtailed supplies at these prices and dependence on Australian sources increased.

In 1948 Australia was requested to see if production could be stepped up as the U.K. would be short of meat for a considerable post war period. A long term meat agreement was signed in 1952 for a 15 year period.

This agreement was signed when meat was still under control and provided that production would continue on the free market. But there were difficulties of prices and distribution. Satisfactory methods of returning monies, earned under the long term agreement, to the meat industry were hard to achieve. Distributions have to be made in retrospect and not to individuals. So that payments may be made in current earning year the Meat Board has to predict future prices for the year with a forward guarantee. This system operated last year with, Mr. Shute said, quite a measure of success.

The post war and post control problem is caused by a number of changes. The U.K. has made spectacular efforts to increase home production and is now producing 63% of its own meat requirements, as against 53% pre war. Australia, Mr. Shute believes, must look ahead beyond the long term Agreement and adjust to future marketing problems.

The market demands in the U.K. now are similar to pre war but less fat is required in the meat, therefore re-orientation of production ideas is required. It is not easy to change production patterns of North Australia but provided we can continue to get satisfactory prices this can be done.

Mr. Shute considered that the sooner Australia can switch to chilled beef the better, despite the present saleability of frozen beef. Argentina under Peron (1951) provided frozen carcases of ideal beef type suitable for chilling. New Zealand is swinging over to chilled beef production, the producers are subsidized and an upper weight limit of 650 lbs. dress weight has been applied.

Australian problems are different as we are unable to top off on crops and improved pastures as is done in Argentina and New Zealand. The best Australian beef is home consumed; meat for the U.K. market coming from the ranges. However, the chilled beef production for export is expanding but does not compare with either Argentina or New Zealand.

In the U.K. there is a definite prejudice against frozen meat; the housewives are usually blamed, but Mr. Shute blames the butchers. The problem with frozen meat is thawing out; this takes 3-5 days and means that the butcher must have space for 3-4 days stored supply. The meat also lacks character and is messy in appearance. A large experimental programme is under way to investigate the properties of frozen meat compared with chilled meat. There is no difference on the plate, food value is the same, so the prejudice is purely a matter of market or a function of the butcher. Australia suggested that a thawing out centre be established in U.K. This avenue, however, was found to have been tested commercially as a number already existed. The frozen products have to be marketed quickly as they do not stand up to U.K. butchers' marketing conditions.

The problem arising from this switch over to chilled beef is that of transport. The maximum travelling time from Argentina to U.K. is 21 days while from Australia it may be up to 70 days, so the problem of bacterial breakdown is important and calls for the use of gas or antibiotics. The medical profession, however, questions the wisdom of this use of antibiotics. Shipments have been made, however, and results are being awaited. But the biggest problem for Australia is transport, both internal and external.

Mr. Shute is of the opinion that Argentina holds the key of the situation with its potential for production, with beef production stimulated; possibly though, this may be due to disposal of beef cattle prior to a switch over to cropping.

**Application of Research Findings to Industry.**
*Dr. R. T. Clarke, Co-ordinator of Beef Cattle Research U.S. Department of Agriculture.*

Dr. Clarke commenced by reminding the audience that today's research is tomorrow's progress and the sooner research results can be put into practical application the greater would be their application. Expenditures were not great, they may seem large in total but small with regard to the size of the industry.

In the U.S.A. extension work is operated on a "team basis" which is similar to some extent to the Australian system. The last phase of research is dissemination for which farm advisers are responsible, carrying information to the field and reverse data back to the scientist; thus they form a listening post. Many of their problems can be answered from present knowledge but many of the queries provide material for new research.

Extension workers have found that rather than long wordy publications, short colourful bulletins of not more than 25 pages attract the attention of the farmer. This has entailed a new approach, Dr. Clarke said, which is one of abbreviation. The next significant change in extension methods is that the farm press has now highly trained reporters who comb research laboratories for appropriate scientific information. This does cause some difficulty, as knowledge is passed on before complete answers have been obtained, but it has revolutionized the application of research to production. It is found that the majority of data now first appears in the press and what can be applied is utilized immediately. Some scientists, a minority, are in opposition to this approach. Dr. Clarke referred to these as the "Cloistered scientists".

Dr. Clarke maintains that the increased farmer awareness obtained by these methods has led to greater producer support of research. Farmer resistance is broken down more quickly by this more alert press reporting. Also this system frequently means that the scientist sees his results practised within his own lifetime. A case quoted by Dr. Clarke was the use of Stilboestrol in beef cattle. Whilst basic research is still in progress millions of animals are being effectively treated with this chemical, more than two-thirds of the cattle in Iowa having been treated. By contrast it has taken at least 45 years to popularize progeny and production testing of beef cattle. Breed Societies have put complete dependence on "eye-ball" judgment in meat production and selection is not sound. But, Dr. Clarke said, a U.S. Beef Cattle Record Association has been set up after many years and future producers will buy and sell on known performance—as the U.S.A. press puts it: changing from "cow puncher to card puncher". Several cents per lb. premium being paid if histories are known.

In both Canada and the U.S.A., Dr. Clarke said, the performance of testing beef cattle is being televised, the cost is high, but Dr. Clarke believes it will eventually be undertaken in Australia as these programmes are effective and useful. Also some centres are going back to the "old idea" of demonstration farms in certain areas; most States, however, discarded this approach back in 1950.

**Some Chemical Properties of Soil at Muttaburra.**
*V. R. Catchpoole, Faculty of Agriculture, University of Queensland.*

In the Western Queensland semi-arid zone, soils are being used for sorghum production. Soil analyses were performed with soil from an area at Muttaburra in Central-Western Queensland, in Mitchell grass downs country. This area has an annual rainfall of 16.4 inches and an N.S. quotient of 40.

Prescott's soil map shows that the grey and brown soils of heavy texture occur at Muttaburra. The soil reaches 5 feet in depth and is developed on calcareous sandstone of the Tambo series. The most obvious features of the profile are the zones of accumulation of calcium carbonate and gypsum, and the yellow C horizon of mealy structure. Soil horizons are not well developed in the solum, and mechanical analysis has shown that clay, which reaches 50 per cent., is evenly distributed with depth.

The soil is mildly alkaline (pH 7.3-7.8) with a maximum pH value of 8.1 in the surface 2 inches. In spite of a zone of accumulation of calcium carbonate and high values for exchangeable sodium, pH does not increase with depth, probably due to the presence of soluble neutral salts.

Calcium is the predominant cation reaching 90 per cent. of the total cation in the surface soil. This saturation decreases with depth, whereas magnesium saturation increases in depth (maximum in fourth horizon). The soil is well supplied with potassium, having 1.4 me.% which is 2.7 per cent. of the total cations. High exchangeable sodium values of 13 me.% (26 per cent. of the total cations) occur in the subsoil. The exchange capacity per 100 gms. of clay is 90 me%, suggesting a montmorillonitic clay.

The soil is low in total phosphorus, the solum containing up to 200 p.p.m. There is no recognisable trend in total phosphorus with depth. A high content of phosphorus in the C horizon, 700 p.p.m., suggests layering of the parent material. The soil is poorly supplied with total nitrogen, surface soil containing 0.05%. As is typical in grassland soil the nitrogen content decreases regularly with depth. The C/N rate of 8 is very narrow and narrows sharply (to 3.3) in the C horizon.

**Symbiosis of Sub-Tropical and Tropical Legumes.**
*G. D. Bowen, Plant Pathologist, Department of Agriculture and Stock, Brisbane.*

Only some ten per cent. of the ten to twelve thousand species of Leguminosae have been observed for nodulation. Nodulation has now been observed on 112 of Queensland's 557 indigenous legume species.

Only about 500 leguminous species in 105 genera have been studied with respect to cross inoculation. Most of the Australian indigenous legumes which have been studied in this respect

belong to the large cowpea miscellany as do the tropical legumes which are used in Queensland.

The occurrence of the cowpea type of *Rhizobium* is widespread in Queensland. In the tropical parts of Queensland the nodulation phenomenon has not been found rare or lacking, as has occasionally been reported elsewhere in the tropics.

Although several cases have been recorded where nodulation occurs on tropical pasture legumes from naturally occurring legume bacteria, large increases in growth and protein content have been recorded from inoculation in many cases.

This has been due in most instances to a marked host specificity within the cowpea "cross-inoculation" group and occasionally to higher nitrogen-fixing capacity of an inoculated strain relative to that of the naturally occurring organisms.

Some hosts such as *Vigna sinensis* and *Phaseolus lathyroides* nodulate with a wide spectrum of organisms of the cowpea type, and this probably is a big factor in the widespread successful growth of these legumes and their consequent popularity.

Prediction of the behaviour of an organism in respect to the various hosts is difficult. Differences between genera and species within a genus are recorded. The information at present available does not permit the drawing of sound conclusions based on existing taxonomic relationships. There are also certain objections to the hypothesis that the degree of host specificity is a function of the degree of cross-pollination of a species. There is a serious lack of data on the buildup of fertility in the field by tropical legumes.

### Drought Feeding of Cattle.

*J. G. Morris, Animal Husbandry Officer, Animal Research Institute, Department of Agriculture and Stock, Queensland.*

Research with sheep in other centres on survival requirements under drought have shown that for survival, requirements are appreciably less than indicated by conventional feeding standards. The importance of Queensland's cattle industry has made investigation of their drought requirements necessary. Greater feed requirements, and more difficult management introduces high cost in such research and a consequent difficulty in obtaining statistical significance.

Available drought fodders in Queensland are: conserved roughages (bush hay or conserved crops), limited quantities of high energy food (grain sorghum), and a limited quantity of high quality feedstuffs.

An experiment in feeding with bush hay of *Paspalidium globoideum, Eriochloa* spp., *Dicanthium sericium, Aristida leptopoda* and a small percentage of *Iseilema membraceum* and *Panicum* spp. was described. Crude protein was 4.6% with an apparent digestibility coefficient of 24.1% (sheep). Crude fibre was 34% with a digestibility of 54.6%.

Four groups of six heifers 1½-2 years old were fed respectively bush hay *ad. lib.*, bush hay *ad. lib.* and 1.3 lb. prime quality lucerne chaff, bush hay sprinkled with 0.4 lb. meat meal per head per day. All animals were dosed with Vitamin A and all groups had access to a mineralized lick.

Weekly body weights over a six-month period showed that the average body weight of the group fed bush hay and lick only remained stationary for thirteen weeks and then declined slightly. The groups receiving supplements of lucerne chaff or meat meal in addition to bush hay gained in weight. These supplements also increased the mean average bush hay consumption. The greatest increase was in the group receiving meatmeal—a sixteen percent. increase over the control group for the six-month feeding period. However, the total intake was approximately the same for the meatmeal supplemented group as for the low lucerne (1.3 lb./head/day) supplemented group. The same quantity of protein is in 0.4 lb. meatmeal as in 1.3 lb. lucerne.

The mean average consumption of lick by the unsupplemented group was approximately twice that of the high lucerne group.

An increase in consumption of bush hay by the meatmeal group compared with unsupplemented, appears to be due to an increase in rate of passage or rate of digestion.

The results of the experiment were in accord with those observed for sheep in regard to both requirements for survival and the effect of protein supplement on *ad. lib.* consumption of low quality roughage.

From the practical consideration it has been shown that bush hay may be used as a drought reserve fodder to maintain maiden heifers in poor store condition for six months, provided they are confined to small areas close to water.

### The Changing Pattern of Agriculture in China.

*Selwyn Speight.*

Mr. Speight, who is on the staff of the Sydney Morning Herald, was a war correspondent in China during 1942-44 when Japan was in control of most of that country. During that period Mr. Speight found China a fascinating country that was just emerging from a period similar to the European Middle Ages. There were still many sedan chairs in use and the wheel was just being introduced; these glimpses of a past age could not be found elsewhere. Mr. Speight formed the opinion then that China was not a mysterious different place but rather like King John's England but with a few modern additions such as Hollywood films, philosophers, Yanks and a few modern inventions.

During the war there were no roads, instead he moved by foot through paddy fields and saw the misery of a country long since passed its means of subsistence. The main duty of the Chinese was to look after his family first and then his country later. This attitude affected the development of the country.

At the beginning of 1956 Mr. Speight revisited China. On his arrival, Mr. Speight found a tremendous change. There is a fantastic worship of cleanliness; all the picturesque old things

are gone; there are no beggars and the Chinese dress has changed to blue suits!

To obtain local flavour and observe the countryside, Mr. Speight travelled by train to Peking which, he believes, is one of the most beautiful and fascinating cities in the world. From Peking he travelled over as much of China as was possible.

The broad conception of the origin of Communism in China is that the Communists offered to feed the starving country if the people of that country in return promised to obey the Reds. To a hungry people regimentation does not matter. Chinese communists are followers of Marx, Engels and Stalin and are not following the current Russian line of thought. Stalin's method will most quickly move a backward country into an industrial society but is definitely "un-Chinese". Industrialization is a must, as at the present rate of increase, the country will have a population of 1,000 *million people by* 1980, which even in a country the size of China is tremendous. The problem then will be one of water, for food production, and space.

The Reds have developed forest assets on a huge scale especially in the old desert area where they hope by this means to improve the climate. The Yellow River is being harnessed by 42 dams; these dams will be used to provide hydroelectric power and for irrigation. The river banks are being built up to prevent flooding of the surrounding country, much of which appears to be below the level of the river and is subject therefore to serious depredations while the river becomes silted.

6,000 miles of railway have been built in the six years of Red control and also many miles of roadway; a road has been built into Tibet over the high plateaus with one pass at 17,000 ft., where it is necessary for all drivers to use oxygen.

Mechanical farming is being introduced, in some places with community tractors; another big step forward in other areas is the introduction of steel ploughs pulled by horses, instead of the old wooden ploughs previously used. To introduce mechanization the old system of very small bordered holdings has been eliminated and these holdings have been put together into larger areas.

The food problem is being met by attempting to grow three crops, two of rice and one of wheat, on blocks where previously only one crop was grown a year. To counteract loss of fertility nitrogen factories are under construction to produce nitrogen for replacement in the soil; no mention was made of the effect of this continual cropping on the soil structure and organic matter however.

Large iron and steel works and chemical industries are all under way and large scale geological surveys have found previously unsuspected deposits of essentials such as iron, copper and oil. Rubber and wool are at present the only outstanding imports that the country requires and if the movement of population to Tibet is undertaken as envisaged the requirements for wool will be high.

The big problem of illiteracy is also being tackled by the Reds. They are starting by romanizing characters and reading from left to right, and later they hope to introduce roman letters instead of Chinese characters. By this means, Mr. Speight said, it is hoped to give many people a basic elementary knowledge and increase literacy in the next seven years.

Mr. Speight found that the Chinese intend to gradually absorb all groups of people around them, such as the Tibetans. In this movement people are being pushed around a lot but the Communists are being very careful of minorities as, if they can avoid it, they do not wish for trouble from these groups in the future.

**Agriculture and its Problems in the Near East.**
*F. L. Shier, Superintendent of Wheat Farming, W.A. Department of Agriculture.*

The countries of the Near East experience a wide range of climatic variation, from the winter rainfall region of about 40" along coastal Lebanon and North Syria to the dry deserts of the Saudi Arabian peninsula. Agriculture is therefore varied as may be seen in the following illustration:—

On the Mediterranean coast of Lebanon and Syria we have conditions similar to South Western Australia—citrus, apples, pears with similar vegetable and garden crops. Olives on the hills and bananas on the plain are common. Where there is irrigation there are crops like tobacco, rice and sugar cane. On the eastern side of the mountains, cereals become more prominent, wheat in the wetter areas and barley as the country approaches the steppe and desert.

Cotton is a major and expanding crop, particularly in Syria. A good deal is grown as a dry land crop but the main expansion is along the major rivers following large irrigation projects with concreted channels, tractor land preparation and so on. Cotton fits in very well with the family unit and income figures like £250 Stg. per family have been reported by major operators. In 1950 production was only 10,000 tons but it has expanded rapidly to 79,000 tons in 1954 and 91,000 tons of fibre in 1955.

Wheat and barley are major items in the Middle East and every farmer or villager grows some wheat. In Iraq in addition to cereals, an important industry is dates. Some 90% of the world's dates come from Iraq. In Turkey, in addition to the large cereal industry, there is a large animal population. In all there are about 65,000,000 head of livestock, including 27,500 000 sheep, 20,000,000 goats and 11,000,000 cattle.

The governments of the countries of the Near East with help from F.A.O. are endeavouring to raise the living standards of the people, and it was obvious the rural communities were at least getting enough to live on. However, it was realised that any drastic changes could produce strong opposition from the people it was hoped to benefit most. At Government level there is a clear appreciation of the value of technical services and positive action has been taken towards commencing agricultural education, research and extension programmes. Inter-

national organisations are encouraging this development through fellowship programmes which enable selected personnel to gain overseas experience. For example Iraq maintains about 1,000 students overseas all the time in all fields of higher education including 200-250 in agriculture and related subjects.

In the fields of crop and animal husbandry, at first sight they appear vastly different and extremely strange. However, with reflection it is realised that they are not so primitive and they do fit in well with the environment and economic and social set up. Husbandry of both crops and animals can best be described as "traditional". With sheep for example, all are of the fat tail type with a low wool yield of 4-6 lbs. This wool is a coarse carpet type, but the sheep concerned produce a large quantity of milk and the ewes are milked as a normal procedure. The flocks are small and shepherded and often restricted in size by the number of ewes the shepherd can milk. The return from a flock is roughly 55% from meat, 30% from milk and 15% from wool. Of the wool, some 15% is coloured brown or black and after treatment some 90% is exported to the United States.

The most suitable methods of improvement lie in a programme of simple selection for, say, sheep producing non coloured wools, husbandry improvements and disease and pest control. Marked increases in meat, milk and wool yields would follow a programme of selection.

In conclusion it was pointed out that some of the major obstacles which must be overcome, and which will have a bearing on the rate of future progress are such things as:—

1. The Arab philosophy of contentment.
2. Problems of land tenure.
3. The building up of a professional public service with education, research and extension sections.
4. The development of a national outlook by the people themselves to the improvement of agriculture as a whole, rather than the present tendency of an individualistic and even selfish attitude.

**Papers Presented at General Meeting Western Australian Branch—July 20th, 1956.**

## Chloride Content of Tobacco Leaf.

*Mr. N. Halse—Research Officer, Department of Agriculture.*

Tobacco is sold according to quality, and this is determined by its appearance, colour, texture and smoking quality. Smoking quality is determined by a panel, and by this means an area becomes known as to the quality of its leaf. West Australian tobacco is not considered to be of high quality by manufacturers, and this is attributed to the high chloride content. High chloride content causes leaf to burn poorly and in West Australia the content is sometimes as high as 5% on a dry matter basis, whereas most other tobacco areas produce leaf with less than 1% chloride.

The cause of this high chloride content in W.A. tobacco leaf is not exactly known. The crop is usually grown on summer moist land and it appears that under these conditions there is an accumulation of sodium chloride in the soil, resulting in salty leaf. Even under irrigation the chloride level is too high. An important aspect is the extreme variability of the chloride of the leaf in the field. Attempts have been made to control this in the glasshouse, and the following studies have been made.

1. The effect of varying levels of chloride in the soil medium.

2. Possible differences that may occur within varieties. This could produce a direct result or give a basis for breeding.

3. Effect of pH.

1. Two pot trials in the glasshouse were carried on

(a) Soil kept at field capacity with water containing varying levels of chloride at 0-16 m.e. (0-64 grains/gallon)

(b) As above but on sand culture.

Of the two, the plants in sand culture grew much better, and poor growth in the soil caused considerable variation. The overall results were similar giving a linear relationship in each case.

% Cl in Leaf (d.m.b)

| Nil | | 16 m.e. |
|---|---|---|
| .1% Cl | ——— | 8% Cl |

Additional information was supplied by a field irrigation trial with water containing 8 grains/gallon of Cl. Results were:—

| No Water | 3 Waterings of 1" | 8 Waterings of 1" |
|---|---|---|
| 4% Cl | 5% Cl | 6% Cl |

These differences were significant, and showed that chloride content could be increased to high levels even with good water. The trials also showed that chloride accumulates continuously during growth, and that there is very little redistribution.

2. *Varietal Studies*

(a) Pot trial with 20 varieties. However growth was too vigorous and results were misleading. However some differences appeared.

(b) Repeated with 8 of the varieties which were prominent in A. There were no differences.

A field trial also showed that there were no differences between the varieties.

3. *Effect of pH.*

Pot trials were carried out with 4 treatments.

1. No soil amendment.
2. The equivalent of 2000 lbs/acre of $CaCo_3$.
3. Same amount of calcium as gypsum.
4. Same amount of calcium as calcium gluconate.

*Approximate Results.*

| *Treatment* | *Nil* | *Gypsum* | *$CaCo_3$ & Ca gluconate* |
|---|---|---|---|
| Ph | 5.95 | 5.5 | 6.5 |
| Cl content | 3.5% | 3.6% | 2.1-2.4% significantly lower. |

### The effect of Lime on the Growth of Sub Clover on an Acid-Peaty Soil.

*Mr. N. Fitzpatrick—Research Officer, Department of Agriculture.*

This paper was supplemented by a series of kodachrome transparencies which illustrated the nature of the country under discussion. The areas are noted for their high water table and the peaty nature of the soil. Plants grown without the application of lime were small, the leaves were pinkish and had 'burnt' edges. There was a restricted growth of the top root and laterals, together with a general thickening off and browning of the roots.

The pH of these soils and the effect on pH by the addition of lime may be shown as:—

| | | |
|---|---|---|
| Virgin Soil | pH = | 4.5-5.0 |
| 2 Months after lime | pH = | 5.6 |
| Late Season (Nov.) | pH = | 4.9 |

The question that now arose was whether the beneficial effect of lime was due to the effect on pH? Both pot and field trials using $CaCo_3$; Mg $Co_3$ and $CaSo_4$ were undertaken to study this problem. In pots $CaCo_3$ gave a much greater yield than $MgCo_3$ and both $CaCo_3$ and $MgCo_3$ gave greater yields than $CaSo_4$. In the field trial although $MgCo_3$ gave an equivalent yield to $CaCo_3$ $Na_2$ $Co_3$ did not give an equivalent yield.

Thus from the results of both series of trials it appeared that the effect of lime was not due solely to an increase in soil pH, but that apart from benefiting from the increase in pH, the sub-clover required an available source of calcium.

A calcium source without any side effects was now tested, and for this purpose calcium gluconate was used at a rate calculated to give an equivalent amount of calcium. Beneficial responses were obtained. Soluble calcium phosphate was used but produced symptoms corresponding to phosphate toxicity.

In conclusion it was pointed out that no other elements had been shown to influence plant growth by themselves. Nitrogen deficiency was commonly observed due to the lack of nodulation. The restricted development and thickening of the roots were typical of symptoms found elsewhere in cases of calcium deficiency.

### The Use of X-Ray Mutations in Sub-clover.

*Mr. J. Carpenter, Research Worker, Institute of Agriculture.*

Work on this aspect has been carried out for the past two years at the Institute, and this tool in plant breeding and genetical research has attracted particular attention since the war, especially in the U.S.A. and Canada. Mutations can be artificially induced by:—

(1) X-rays.

(2) Atomic radiation.

Useful mutants had been obtained with oats, barley, peanuts, mustard seed and peas. Usually these mutants were not of immediate value, but could be incorporated into a breeding programme. Also most mutations are usually deleterious, causing sterility, dwarfism, malformations, etc. The progenies of the mutants are screened and a small portion is selected. Specific mutation selection is a laborious task and difficult to practice.

Most mutant genes are recessive and heterozygous in the $F_1$ and thus plants must be reared to the $F_2$. The mutations may express themselves in a change in a character or as complete character changes. These mutant changes may result from:—

(1) Changes in simple genes.
(2) Protoplasmic mutations.
(3) Chromosomal mutations.

To induce mutations in sub-clover, seeds are exposed to radiation of up to 76,000 "Rontgen" units by deep therapy X-ray radiation. The seeds were grown both in the glasshouse and in the field and some results were as follows:—

| Rontgen units | F1. No. Seedlings survived out of 100 Seeds | F2. No. of Seeds | F2. No. of Families | F2. % Families Showing Mutants |
|---|---|---|---|---|
| Control | 54 | 100 | 101 | 3 |
| 19,800 | 62 | 92 | 93 | 12 |
| 35,590 | 41 | 48 | 54 | 24 |
| 56,980 | 30 | 31 | 40 | 37 |
| 66,990 | 28 | 26 | 45 | 44 |
| 76,000 | 22 | 11 | 20 | 25 |

These results show a linear relationship, and the damage to seedlings is due to a protoplasmic effect. Increasing X-ray dosage increased mortality rate of seedlings in $F_1$ and also seeds produced, but increased the % of families showing mutants in the $F_2$ of these mutants:—

44% were chlorophyll mutants.
50% were fully fertile.
30% were fully lethal.

In conclusion, Mr. Carpenter pointed out that sub-clover requires a high X-ray dosage, some 67,000 R units, compared with some 19,000 R. units for cereals. It is important to grow the $F_1$ plants under carefully controlled conditions for maximum survival rate. Following this the ideal is to grow large families of $F_2$ plants so that the mutants can be more fully studied.

### "A Study in the Economic Efficiency of Farms in the Whole Milk Region of W.A."

*Mr. R. Mauldon, Research Worker, Institute of Agriculture.*

This survey was conducted by the University Institute of Agriculture in the whole milk producing area between Perth and Bunbury. There are 520 licensed farmers in the area and out of these some 75 farms were selected as a representative sample. Of these 70 were

actually interviewed. Financial accounts were obtained from 55 farmers and of these 5 were considered to be exaggerated.

Four resources were examined, namely: farm labour, expenditure on feedstuffs, expenditure on fertilizers and miscellaneous outlays. On no farm were all these factors combined in the most economically efficient way. That is to say, that on every farm, profits could have been increased without any extra expenditure by less expenditure in one direction compensated by greater expenditure in another direction. The four resources examined were studied in the light of the following assumptions.

1. Inputs are most profitably organised where marginal rates for inputs are equal.
2. The most profitable level of production is where margin cost = marginal return.

The results had been calculated and the figures indicated that:—

1. Farmers were expending about the right amount on labour.
2. Farmers were over expending on feed.
3. Farmers were under expending on fertilizers.
4. Farmers were under expending on other forms of expenditure.

Further analysis showed:—

| Factor | Unnecessarily High | Unnecessarily Low |
|---|---|---|
| Labour | 39% | 43% |
| Feed | 24% | 71% |
| Fertilizer | 20% | 4% |

About 2/5ths of the farms appeared to be over employing labour and 2/5ths were under employing labour. Approximately ¼ of farms were underspending on feedstuffs and about 2/3rds of farmers were overfeeding. Most farmers who were overspending on fertilizers were underspending on feed.

It was pointed out that farmers as a whole did not understand the principles of concentrate feeding and there was generally an overfeeding in the 3 milk quota determining months. With fertilizers more scientific data was available and this was reflected in the more efficient use of this factor. Other expenditure was probably tied up to a considerable degree with pasture improvement. Underspending could result due to insufficient capital but this was not an explanation at the time of the survey. The only plausible explanation was that farmers considered that unit costs were too high relative to the price of milk.

# SYMPOSIA

## ECONOMIC BARRIERS TO AGRICULTURAL EFFICIENCY.

*A Symposium held by the N.S.W. Branch on 24th May, 1956.*

### Extension Services.

*by Mr. R. Parish, Division of Marketing and Agricultural Economics, N.S.W. Department of Agriculture.*

In discussing the role of the extension services in promoting agricultural efficiency and progress Mr. Parish particularly considered them as promoters and popularizers of new techniques and research findings.

A lengthy period usually elapses between the time an innovation is first introduced and the time it is widely accepted. This delay is not generally due to any lack of knowledge of it by the farmer but because he waits to see it proved practically on some neighbouring farm; the average farmer looks to the most successful (and progressive) farmers in the district for a lead. In a particular area all new developments are usually pioneered by the same very few people. In general, whether or not a farmer is to the fore in adopting new techniques depends on his individual make up, his own background education and experience rather than on his financial resources. Early adoption of new ideas usually comes from the younger, better educated men and particularly those who have had no previous farming experience. In a recent issue of "Punch", Ronald Duncan wrote "As any history of English agriculture will reveal, all the innovations and experiments have always been made by that most maligned class known as the gentleman farmer" and supported this statement with numerous examples.

Mr. Parish considered that there is a minority of 10-25 per cent. of farmers who display managerial and business ability well above the average and who are predisposed to accept new techniques. It follows then that mere multiplication of extension services will meet with a diminishing response because only a small proportion of farmers can be directly influenced. It also is clear that extension effort should be concentrated on this minority with the object of getting some people to use the new technique as soon as possible.

Extension workers should, similarly, always address themselves to the more intelligent of their audience and not worry about the majority. If the argument holds it also means that the quality and training of extension personnel must be high. One of the main ways the quality of extension work can be improved is by increasing its economic content, aiming at a comprehensive farm management service rather than piecemeal technical advice. In conclusion, Mr. Parish made a plea for more applied research, designed to answer the right questions, as perhaps the prin-

cipal means by which the quality of extension recommendations can be raised.

### Rural Credit.

*by Mr. A. J. McIntyre, Agricultural Research Officer, Commonwealth Bank of Australia.*

In his talk Mr. McIntyre took the view that, while there are some gaps in our rural credit services, it is difficult to find much evidence that we could have done much better. During the recent prosperous period bank advances have increased steadily and farmers have not made much reduction in their share of bank advances. In December, 1948, when advances were first classified, their share in the total was 27 per cent. This fell to 18 per cent. in December, 1951, rose to 24 per cent. in December, 1954, and has remained at that proportion since. The farm debt is probably over £500 million of which the trading banks make up £212 million and which is probably not more than 15 per cent. of the present market value of farm assets. Although the farm community has only about 13 per cent. of Australia's total work force and supplies about that percentage of the national income it has 24 per cent. of the total advances of the trading banks.

Mr. McIntyre pointed out that what one thinks about borrowing must in large measure depend on the outlook for the sale of the commodity to be produced. The cost of production of wheat is about 13/- per bushel but we are now selling overseas below that figure and have large stocks so that financial encouragement to produce more wheat looks bad business.

The outlook for wool is better but profit margins have slipped badly. In 1954, according to a Bureau of Agricultural Economics survey, the return on capital in Queensland averaged 16.9 per cent. while on to-day's costs and returns the figure would be 6.5 per cent. If this is the average expectancy in the most prosperous section of rural industry then we cannot expect rural land to be as much sought after as it was a few years ago when there was a marked rise in land prices. Therefore requests for finance for land purchase might decline. On the other hand there could be an increase in requests for "carry-on" finance to help land-holders.

However, there is ample evidence that, during the recent period of prosperity many farmers financed improvements out of savings. A survey of N.S.W. wheat growers has indicated that most of them were planning to finance improvements out of savings. This seems to be general so that credit is not so important to farm improvement as might be thought.

Mr. McIntyre also stated that, despite recent credit restrictions, the number of farmers who have been refused credit to carry out some worthwhile improvement is surprisingly small. In short there is very little evidence that lack of credit has been a barrier to agricultural progress. At the same time there is some doubt whether credit made available has been used to the best advantage. Our extension services are deficient and banks might well employ more specialists who would combine an agricultural knowledge with a business training. Possibly also we need a specialised organisation to ensure that no individual with worthwhile plans for improvement is neglected.

### International aspects.

*by Mr. J. N. Lewis, Deputy Director of the Bureau of Agricultural Economics, Canberra.*

Two of the main international factors which influence the market prospects for Australia's rural export commodities are the spread of national policies of self-sufficiency in agriculture and the effects on our trade of surplus disposals activities and of export subsidies.

The world food situation has changed greatly in the last decade, post-war shortages have given way to mounting surpluses which are the outstanding feature of the current situation. The emergence of large commercial surpluses and marketing difficulties has followed the rapid post-war recovery and expansion of world agricultural output to a level about 30 per cent. above 1946-47 and about 20 per cent. above pre-war. The increases in North America, Africa and the Near East have been much larger than elsewhere. Surpluses are held principally by the United States and surpluses of grains, cotton and tobacco have continued to increase despite disposal programmes and some production restrictions. At the end of March, 1956, the value of stocks of agricultural products held by the U.S. Government was $5.7 billion. Another striking faeture is the relative stagnation of international trade in agricultural products compared with pre-war.

The reason for this lies very largely in the increased domestic agricultural out-put of food importing countries as a result of price policies encouraging domestic agriculture. This trend is likely to be difficult to reverse. Many of these price-support policies are too rigid and herein is their main danger to international trade, there is now a considerable export of subsidized products from countries other than the U.S.A. At the recent F.A.O. Conference the Australian delegation, of which I was a member, pointed out that the surplus problem could not be solved by disposal programmes alone, price support policies should be much more flexible to ensure the flexibility of production necessary to meet changing situations.

The United States is attempting to move her surplus products into consumption overseas by making them available on special terms which include sale for local currencies, barter for strategic materials, grants and donations for emergency relief purposes, triangular deals and credit sales. During the 1950-55 period one-third of the U.S. farm exports was under Government export programmes and the proportion is increasing. In respect of wheat it is over two-thirds. Moving such large quantities of surplus products into consumption without disturbing normal commercial trade presents major problems which have been the subject of much discussion in F.A.O. and G.A.T.T. F.A.O. has drawn up a set of Principles of Surplus Disposal which have been accepted by about 40 countries including the U.S.A. but because of their flexibility and considerable freedom of interpretation they are having little effect.

F.A.O. has considered methods of surplus disposal, in particular the possible use of surplus agricultural products for financing economic development in under-developed countries. A pilot trial in India indicated that this was possible

but perhaps difficult in practice. Mr. Lewis considered that U.S.A. could do far more to dispose of her surpluses internally and that Australia should continue to resist the "dumping" of surpluses on world markets.

It was concluded that while these international barriers to trade were serious limited market opportunities overseas should not prevent Australia from maintaining a satisfactory rate of agricultural development. There is considerable scope for cost reduction and quality improvement in many of our farming industries and we have opportunities for some agricultural import replacement of our own with crops like cotton, tobacco and oil seeds.

The meet the challenge of barriers on the marketing side we will need to ensure that we are not impeded by barriers of our own making or which we do nothing about removing. Two such are inadequate credit facilities and attentuated extension services.

### Recruitment of Agricultural Scientists.

*A.C.T. Branch, July,* 1956.

On the 12th July, 1956, the A.C.T. Branch of the Australian Institute of Agricultural Science entertained the Standing Committee on Agriculture of the Australian Agricultural Council, at a buffet dinner at the Hotel Canberra. The dinner was followed by a Branch meeting at which the present efforts of the Institute to recruit agricultural scientists were discussed.

The meeting consisted of four prepared papers given by Dr. E. Phillis (read in his absence by H. Lloyd Davies), Mr. R. Milton Moore, Mr. W. M. Willoughby and Mr. Frank Grogan. The addresses were followed by a discussion in which both members and visitors took part and are reported in detail.

*Paper by Dr. E. Phillis.*

It may be taken for granted that there exists in the minds of all agricultural scientists a firm conviction that Australian agriculture would benefit enormously from an increase in all branches of research work, extension and demonstration.

In view of such a declaration of faith, the Institute's policy of encouraging recruitment to the profession would appear to be fully justified.

There would appear to be other considerations to be borne in mind, however, which should have some influence on policy making.

The chief consideration is that the funds which make most agricultural research and extension possible are provided, not by agricultural scientists, or even directly by the agricultural industry, but are allocated from common funds by administrators who may not be so convinced as the scientists of the need for an increased tempo, and even if they are so convinced, may in all honesty decide that no increased allocation can be made for this purpose from the limited funds available to them.

A further consideration arises from the declared functions of the Institute, which include among others—

(a) the protection of the status of the profession of Agricultural Science, and

(b) the safeguarding of the interests of the members of the Institute.

Preliminary reports indicate that the Institute's recruiting campaign has been highly successful, and that universities are showing a great increase in the numbers of students entering Agricultural faculties.

It is pertinent to enquire concerning the chances of absorbing these increased numbers of young graduates into the profession in two or three years time.

A supply of graduates in excess of available positions can only lead to dissatisfaction and disillusion. A training in Agricultural Science, unlike a training in pure science, is very much of a one-way street, and it could justifiably be feared that a surplus of graduates with very limited avenues of alternative employment could become an embarrassment both to the profession and to the Institute.

It should be the Institute's aim to so improve the general status of the profession, including the working conditions attached to posts, that recruiting campaigns become unnecessary. Instead of an unrestricted recruiting campaign, it should be the Institute's function to advise each year on the desirable student entry, not in the restrictive sense of keeping the number of graduates available below the number of posts, but to so adjust recruitment in terms of posts that no appreciable unemployment develops. There should always be some competition, for in no other way can keenness and ability be so readily maintained. Excess competition could be deleterious in a number of ways. Firstly it could militate against any improvement in terms and conditions of employment for agricultural scientists. It could lead immediately to a drop in the quality of personnel available in that it is just those bright, capable graduates whom the profession should strive to keep that will be most able to find alternative employment. Furthermore, once the profession acquires a bad repute, promising students will avoid it in favour of others showing better promise.

The present policy of enthusiastic recruitment can only be justified if it is reasonably certain that satisfactory positions are likely to be available for the majority, if not all, of the student body on graduation. Would it not be possible for the Institute to make, after consultation with the various employing organizations, a sober, realistic estimate of the number of posts likely to be available in each year, and to so advise on recruitment that an unemployed surplus does not develop? In making such an estimate wishful thinking that the profession ought to have heavy reinforcement should be avoided at all costs.

The Institute should not encourage students to enter Agricultural Science courses unless it can assure the students that their future prospects are at least comparable with those of students entering other faculties.

Would it not be possible for the Institute to begin the compilation of a register of all Agricultural Science students who have graduated since, say, 1950, or who graduate in future years,

with some indication of the nature and conditions of their employment? Comments from such graduates concerning any difficulties in obtaining employment and on the terms and conditions of their employment, especially in comparison with colleagues who passed through other faculties, as well as on any special points they might care to make concerning these posts, could form a very useful background for the Instiute's policy on recruitment.

The suggestion of a survey on the nature, terms and conditions of employment of recently graduated entrants to the profession is in no way intended as a reflection on those who have guided, and still are guiding the policy of the Institute. It is in the nature of things that such matters should be in the hands of established members, who, by reason of their seniority, may not be fully cognisant of developments at graduation level; the proposed survey should help to keep them reliably informed on such topics.

*Paper by Mr. W. M. Willoughby.*

In recent years a vast new agricultural and pastoral potential has been unveiled in Australia largely through the work and vision of several worthy members of this Institute. Recognizing that this potential exists, and realizing that its exploitation will require a great increase in agricultural research and extension, the Institute has been carrying on a programme of encouraging recruits to the faculties of Agriculture. Such a programme would presuppose—

1. That Australia, through its administrators, is aware of this agricultural potential.
2. That it intends to pursue an increased programme of development to exploit it.
3. That it will unhesitatingly provide more funds for salaries, equipment and facilities for more agricultural science graduates.

If the Institute has not been assured that 3. above will eventuate, then its recruitment policy is unwise and unjust for such a responsible body. A surplus of well trained people in excess of proper positions can only lead to a lowered chance of maintaining the present salary ratio with other professions, and certainly cannot improve it; so that one of the reputedly attractive features used to encourage recruitment will become less attractive, and recruitment will fall.

The overall outcome of the recruitment policy could therefore be—

(1) a lowering of salaries relative to other professions (which would be difficult if not impossible to rectify with unemployed or inadequately employed graduates available), and

(2) an average level of recruitment (mean of the stimulated peak plus the subsequent trough) no better than the normal.

It is hoped that the position never arises that adequate employment opportunities do not exist for graduates, and that if this Institute is doing nothing about it, someone else is. It is also hoped that salaries will remain as attractive as we are now informed they are. In which case we should expect a good natural recruitment, without resource to artificial encouragement. On the face of it, a university training in agricultural science, and subsequent employment in a well paid position seeking new knowledge, adapting it to practical use and disseminating it to the man on the land for the well-being of this nation, is a fascinating vocation. But if we look deeper we find that few agricultural graduates are encouraging their own sons to enter the profession. The father to son tradition so strong in other callings is peculiarly lacking in ours.

I would suggest we know that there are disturbing aspects of the profession that seriously outweigh the apparent advantages. These are so disturbing as to hinder and prevent many graduates from applying their training and experience to the development of Australian agriculture, to the point of frustration. Since we are urging others, but not our own, to join, it is pertinent that we should examine these aspects.

Firstly, the agricultural science course aims to stimulate scientific curiosity, develop scientific initiative and create enthusiasm for applying the university training to agricultural progress. In many instances on taking up employment the graduate finds that, far from these attributes being welcomed, guided and encouraged, they are actually repressed. When a university lecturer in agricultural science expresses bitter disappointment—as one did to me—that many of his students, often the most brilliant, are reduced within three years to non-thinking automatons, out of touch with scientific development, their initiative and enthusiasm gone, and often gone beyond decent repair, then it is something of which this Institute should be aware, and should do its utmost to correct. To make the picture even worse, alternative employers are few, and often the graduate is working under a bond.

Secondly, if this Institute were consistent, it would be recommending, if recruitment be necessary, cheaper and shorter training than the University degree course. Some years ago in a plebiscite on qualifications for membership, a case was adopted which included the contention that the cheaper training was often as good as a degree. In so doing the Institute condoned and endorsed the action of some employers who give graduates no better status than those without university training. In such employ the salary is naturally based on the alternative qualification and the graduate finds himself in an environment not only unsympathetic to scientific thinking, but even critical and scornful of it.

Thirdly, completely unlike any other profession, the agricultural scientist in many instances is expected not only to be skilled in all manual operations of all subsidiary and allied trades, but also must be prepared to perform them, often more or less constantly, in the course of his duties. Worse than that, often he must perform them on behalf of a more senior officer. What other university trained profession uses its graduates to do the labouring duties on the brain child of a more aged graduate? Even more ludicrous, the equipment at the field worker's disposal is often the most outmoded in the country. As a labourer he is most expensive. As a scientist his abilities are wasted.

Fourthly, in many positions the agricultural graduate, already struggling with the above disabilities, is further burdened with sub-standard living accommodation, and/or a life of continuous

transfer, without regard to home, wife, children or their education.

The efficient usage of present agricultural graduates is being hindered in greater or less degree by the operation of one or more of the above factors, viz. inadequate salaries, stifling of initiative, repression of enthusiasm, non-appreciation of university training, manual nature of many of the duties, lack of equipment and poor living conditions. These are also acting as deterrents to recruitment, and at the same time make a recruitment policy more necessary. Recruitment would not be necessary if this Institute put its own house in order. Many of the above displeasing elements are within the power of the Institute to rectify internally, and rectification is urgently needed.

With the internal treatment applied and successful, the Institute could then argue with more conviction and force on behalf of its members. Surely the doubling of the proper work output of each graduate at an expenditure less than double that spent on his present salary and facilities is good business for Australia.

Until we ourselves and subsequently the community are willing to give the agricultural science graduate duties and responsibilities worthy of his training, together with facilities to perform these duties efficiently, then despite the inveigling of school students into the faculties, the agricultural and pastoral development of Australia will not be suitably accelerated, and the objectives of this Institute will not be realized.

*Paper by Mr. R. M. Moore.*

During the past two years the Institute has been endeavouring to induce young people leaving school to enter one or other of the various Faculties of Agriculture in the hope by so doing the shortage of agricultural scientists in Australia would be alleviated. Some members of this Branch have questioned the propriety of the Institute's so-called recruitment campaign on the grounds that it is not in the best interests of either the present membership or of those recruited.

As the immediate Past President of this Branch and a member of Council during the period when the recruitment campaign was initiated, I felt it was incumbent on me to state my own attitude and my reasons for supporting Council's action in this matter.

Firstly, there was an undisputed demand for trained agricultural scientists in schools, extension services, research institutions and industry which could not be met by the then supply. In 1954 Dr. Phipps, then General President of the Institute, estimated that the requirements of Government and Industry for agricultural science graduates was of the order of 160 per year over the five year period between 1955 and 1960, or 800 in all. On the basis that, on the average, only 50% of those entering first year eventually take degrees, a yearly intake of 320 would be required to meet the annual demand estimated by Dr. Phipps. Now the total first year intake in all Faculties of Agriculture this year is 260—this is the figure which is regarded with apprehension by some of our members—but if only 50% will pass, and this seems to be true for Melbourne and Sydney at least, the 1960 output will be of the order of 130, which is below the estimated demand.

At the time the Institute decided to publicise agricultural science the intake of our Faculties of Agriculture was much lower and it seemed eminently reasonable that the Institute composed of the professional agricultural scientists of Australia, a country highly dependent on its agriculture, should take a broad national viewpoint and do what it could to increase the supply of agricultural scientists. Now it may be argued that an Institute which by its Constitution has a responsibility for the status and welfare of its members, from a purely tactical viewpoint, should do nothing positive to disturb a situation in which demand exceeds supply. I personally question such an argument. I do not believe that in a highly socialized profession such as is agricultural science conditions of employment are entirely or even largely determined by scarcity in relation to demand. The only noticeable effect of short supply has been a small rise in starting salaries and even this may be more truly a reflection of the general economic situation than a supply and demand effect.

My personal opinion is that the Institute's constitutional responsibility for the status of its members can be met most effectively by publicising the contribution agricultural graduates make to Australian agriculture and that the greater the numbers in the profession the greater such contributions will be. I therefore believe that in its efforts to relieve a shortage of agricultural scientists the Institute is attempting to make a worthwhile contribution to Australian agriculture and that this is not against the best interests of its members.

Turning to the next point—Is the recruitment campaign against the best interests of those recruited? It might be considered somewhat improper for a professional body to attempt to persuade young people into particular courses of study at a university. How could one argue for example that agriculture is "better" than archaeology? The one, for example, offers greater prospects of employment but, for a particular individual, less intellectual satisfaction than the other. However, it is perfectly reasonable for a professional body to publicise the fact that its profession exists, that it necessitates such and such training and that its members do such and such kinds of work. This is essentially what the Institute has done in its brochures, articles in school magazines and exhibits. It has provided information—about which the largely urban population of Australia is sadly ignorant—to interested students, to school counsellors and others responsible for guiding young people in their choice of university studies.

Having attracted students to Faculties of Agriculture by its publicity, has the Institute the responsibility of ensuring that they have suitable employment in the profession when they graduate? The employment situation in Agriculture at any particular period of time is not determined solely by national needs but largely by Treasury policy and this makes forecasting difficult. Apart from trying to estimate the possible vacancies and being aware of vacancies when they do occur, it is doubtful whether the Institute can assume any great responsibility for placing

graduates in suitable employment. Suitability will be determined largely by the graduate's own interests developed during his four years of study. How can the Institute know this in advance? While there is little doubt that the majority of those graduating in agriculture will enter the profession of agriculture, a proportion will not. On the other hand, a proportion of graduates in faculties other than agriculture will enter the profession. This is a desirable state of affairs as students should not be expected to make an irrevocable decision as to their future careers at the time their university training commences.

In my opinion the Institute need have no qualms if its publicity campaign results in more students taking courses in Agricultural Science of the kinds given in Australian universities. In the field of science it more nearly approaches the ideal of a first university course than most others because of the backgrond it provides in so many sciences. As a basic course for post-graduate specialization in any of the botanical sciences the Agricultural Science course has much to commend it, and as post-graduate training is fast becoming an essential for a research career, the agricultural graduate is under no disadvantage in not specializing earlier. For those not interested in research, an agricultural science course provides entry into a far wider range of positions than other science courses.

There seems little doubt that Australia needs many more agricultural scientists in the fields of education, extension, research and industry. This, rather than the changing situation regarding actual vacancies, is the important factor in so far as the Institute is concerned. I have never been aware of other than a fleeting period of unemployment for agricultural graduates even during the worst years of the depression and the immediate post war years when, due to ex-servicemen enrolment, the numbers taking agricultural science courses were very high.

With the intensification of our use of land for agricultural and pastoral purposes, which is evident already, the number of land-holders which can be served adequately by a single extension or field research officer will decrease sharply and many more such officers will be required. It is up to the Institute to so inform public opinion that agricultural scientists do not remain unemployed while this need exists.

To sum up.

(i) The Institute's current campaign is one of publicity rather than recruitment. Since Australia's population lives largely in big cities, it is reasonable that intending students should at least be aware of the courses in agricultural science before deciding on their university careers.

(ii) Australian agricultural science courses compare more than favourably with other science courses as a first degree course, give students a better background on which to decide their future careers and open up wider avenues of employment than pure science courses. The moral responsibility of the Institute in so far as the subsequent employment of graduates is concerned is less than would be the case if the course were a more highly specialized one.

(iii) There is a distinct need for more agricultural scientists particularly in field research and extension in Australia and this need is likely to increase rather than decrease. By publicising this fact the Institute may well render a service to Australian agriculture.

(iv) The Institute's greatest contribution to the status of members could be the assessment of the problems of Australian agriculture and the publicising of the contributions of members towards the solution of such problems.

*Paper by Mr. F. Grogan.*

Earlier speakers have drawn attention to some implications of the Institute's efforts to bring Agricultural Science before prospective students as a career, and have suggested that the Institute should maintain a watchful eye on the relationship between University enrolments and employment opportunities. They have suggested that, in conformity with its aim of protecting the status of the profession and interests of its members, it should concentrate on improving the conditions of work so that "recruitment campaigns" will be unnecessary.

With the suggestion that the Institution should make an appraisal of the results of its publicity I think no-one will quarrel, least of all those who, as employers, are concerned with the quantity and quality of trained people available. I can only say on this point that I am surprised that the Council of the Institute has not already taken steps to make an assessment of the position if, in fact, it has not. My only suggestion is that if such a continuing survey as Dr. Phillis has suggested is undertaken, it should include the quality as well as the quantity of the intake to the profession. For example, examination of the pre-University performance and the results during their course achieved by agricultural students might reveal that a fair proportion of the most able students were not being attracted to agriculture and that special scholarships or some other form of incentive was desirable. I think it self-evident that no profession can hope to achieve high status and prestige if mediocrity is the hallmark of its members.

Mr. Moore has, I think rightly, queried to what extent the Institute has in actual fact conducted what has been referred to as a "recruitment campaign" and also to just what extent the Institute is morally responsible for seeing there are jobs for those people who, because of information supplied by the Institute, or for any other reason, have taken up agriculture as a profession. He has challenged the assumption that rates of pay and conditions of work in the profession in Australia are basically governed by the scarcity value of agricultural scientists. He has pointed out also the great field of work still waiting to be done, especially what may be called the Applied Research field. If the necessity for this work can be brought home clearly to the general public and to those who provide the funds for research and extension, there should be no need to worry for years to come about employment opportunities for agricultural scientists.

Mr. Moore, therefore, has dealt with the main points directly relevant to the matters raised by the earlier speakers. I wish to make a few

remarks which, while not so directly related to the question of recruitment to the profession, are still relevant, I think, because they relate to the attitude of mind towards the role of the Institute which may underlie some of the comments made tonight.

Perhaps it would unfair to say that for some years the Institute has been criticized for not being sufficiently active and now it is being criticized for being too successful when it has become active. Personally I wish to disagree entirely with the viewpoint that the only, or even the main function of the Institute should be to fight for better salaries and conditions of work for its members, though of course I am not suggesting that it should be indifferent to them. Especially now that we have a paid secretariat I think the Institute should keep a jealous eye on the status of our profession compared to others and should continually collect data so as to be in a position to supply effective ammunition to the appropriate organizations representing the interests of any section of our members. Furthermore it should be able to play a useful role in helping to iron out anomalies between different sections and to build up conditions in all section to the level of the best. May I say quite sincerely that I think some, if not all, of the State Directors of Agriculture are badly underpaid on a basis of work-value and responsibility and that while this is so, all members of our profession in their departments must suffer.

The question will of course be asked, if the Institute is not to devote its major effort to fighting for better salaries and working conditions for its members, then to what aim should it devote its energies? I am convinced that there is a role of leadership with respect to desirable developments in Australian agriculture which the Institute and only it can suitably fill and I feel that our efforts so far in this matter of careers in agriculture, illustrate the point. Leaving aside for the moment the question of how far and how fast these efforts should be prolonged, I think that the Institute was fulfilling its correct function in bringing the need for more agricultural scientists before the general public and in providing the information to enable students to decide whether agriculture is likely to provide in each individual case, a satisfactory career.

Let me clear up some possible misconception on this question of leadership. I am **not** for one moment suggesting that the Institute should attempt to reach a majority viewpoint on all sorts of contentious and difficult issues and then rush into public statements with ex-cathedra pronouncements on the matter. Neither am I suggesting that the Institute when, and if, it does have a viewpoint on some matter of agricultural policy should feel upset, [and suspect its influential members in administrative positions of treason], if the Institute views do not overnight become established policy and procedure.

What I am advocating is that the Institute should be concerned (and in my opinion this should be its main concern) to watch for the problem areas in Australian agriculture and to take the lead on an Australia-wide basis towards informing the public of their existence and importance, and in encouraging the discussion necessary to build up an informed public opinion on any particular matter. It may be asked why can't the Government Departments and Research Organizations do the job just as well or better, than the Institute can. So far as assessing any particular problem goes, of course they can because, by and large, their members are merely the Institute members in another capacity. But when it comes to taking positive and sustained action the position is quite different. Most Government agencies find the greatest difficulty in moving forward much faster than public opinion and very often they have to deliberately move more slowly. I am sure that very often where heads of Departments or even Ministers find their hands tied for political reasons, or perhaps by lack of funds, they would welcome the support which the Institute should be in a position to provide. I think the Recruitment Campaign has illustrated the possibility of such fruitful alliance and suggests that there may be a case for financial grants to the Institute for specific projects or even general purposes. It should hardly need to be mentioned that for the Institute to successfully fill the role I have envisaged, its policies and activities would need to be free from immaturity or irresponsibility. This, I hasten to add, need not mean any surrender of independence or the tying of strings to funds which it might receive.

I don't think I need develop my theme any further tonight. The need for greatly expanded effort in what I have termed applied research, has already been mentioned as a possible field of concern for the Institute: I would have no trouble in mentioning half-a-dozen others which I think could be profitable alternatives to that exciting debate on Section 4 (iii) of our Constitution that has so unremittingly enlivened our proceedings over the past twenty years. Might I suggest in passing, too, that if we do insist on discussing the Constitution, we might devote some attention to whether the present method of central government of the Institute with its tedious backwards and forward reference of even unimportant matters to branches, is any longer suitable or adequate now that we have a paid central secretariat. Consistent policy and firm guidance seem to me absolutely essential and I doubt very much whether the policy of selecting presidents for short terms, on some basis of rotation and sometimes on criteria other than ability and willingness to devote themselves seriously to the management of the Institute, is today appropriate.

May I conclude by expressing my firm conviction that if the A.I.A.S. can provide leadership of the type I have envisaged it will do more for the prestige and status of the profession than by allowing itself to become just another Trade Union engaged in never-ending squabbles for another 10/- per week. When the day comes that this leadership is generally recognized, I think the Institute will no longer be plagued with the question from its member "what do I get for my subscription?"

## Discussion.

### *Dr. R. J. Noble.*

The discussion was opened by Dr. R. J. Noble, Chairman of the Standing Committee on Agriculture of the Australian Agricultural Council. He thanked the A.C.T. Branch for its welcome and hospitality, and expressed his pleasure at experiencing once again the rarefied atmosphere of the higher altitude in Canberra.

On a previous occasion when the Standing Committee was entertained in New Guinea, the Luluai from each native tribe had extended a hearty welcome to the Committee and he was glad to see the tradition being so well maintained by the natives of Canberra.

Dr. Noble said that any consideration of the work of agricultural scientists had to be considered in the light of an individual's desire to perform a public service, and the satisfactions he derived therefrom. In his own experience he had found that, particularly in later life, the opportunity to perform a public service was sought after and valued highly by many of his contemporaries who had successful careers in other fields of work. He found, too, that within his own Department, officers often mentioned the deep satisfactions they obtained from work in agricultural science devoted to the public interest.

So far as recruitment was concerned, he recalled that over the years there had always been doubts about opportunities to absorb the increasing number of graduates. He had no doubt that there was ample scope to absorb many more graduates than were becoming available, for he had faith in the future. He believed that the Institute, and only the Institute, could perform a very great public service by drawing the attention of the public to the importance of agricultural science, and of prospective students to the opportunities for an interesting and rewarding career in agricultural science.

Mr. L. McLennan said that he had a son whom he hoped would matriculate this year but, bearing in mind the salary prospects, he doubted whether he would be giving him the best advice if he told him to enter a Faculty of Agriculture.

Mr. A. Anderson suggested that neither view was exclusively right, and that the Institute might concern itself actively both in the matter of increasing funds and positions available for agricultural research and extension, as well as in the matter of encouraging the younger generation to obtain training and education that would best fit them for such work.

### *Sir Ian Clunies Ross.*

Sir Ian Clunies Ross said he spoke as one of the few persons present who had no formal training in Agricultural Science. He jokingly said he had tried it in first year but it was too hard and he did Veterinary Science instead. At the time he was the only graduating student and he felt this had many advantages, but even in those early days some doubts were expressed about the opportunities for graduates and especially for Veterinary Scientists who were far more specialized and had a narrower range of opportunities than Agricultural Science graduates. These doubts still persisted among some people even though over the years there had been a widening of the opportunities for graduates in Veterinary Science and in Agricultural Science.

He pointed out that an Agricultural Science course provided one of the best basic courses available for a scientific research worker. He had no doubt that the future was assured for the right kind of graduate, and that terms and conditions of service were important, but so was the satisfaction arising from service to the community.

Sir Ian concluded by saying that he thought the Institute's recruitment campaign was a right and proper one.

### *Dr. D. B. Williams.*

The Chairman (Dr. D. B. Williams) thanked the members for their contribution to the discussion. He said that in so far as salaries and working conditions are concerned, there is now a dis-equilibrium between different employing authorities within the profession itself. It would, he believed, be a misinterpretation of the Institute's responsibilties to expect it to do more than to draw to the public attention the effects and implications of the policies being adopted. The decision as to working conditions must then be made by the employing authority in the light of all the circumstances. Of course, by influencing public opinion—including industry organizations among primary producers—the policy may be changed but the Institute's role in this respect should be informative and advisory only.

In its turn, the Institute may well be faced with a policy decision of its own if the employing authorities are unresponsive to its efforts to maintain conditions of adequate reward for its members. This is the heart of Mr. Willoughby's submission—should the Institute continue to support a recruitment campaign if it considers the conditions of employment in some departments or employing agencies are unsatisfactory This is the crux of our present problem, and the weight of opinion seems to be to continue recruiting but to maintain a review of working conditions (which includes a whole range of things other than salaries) in order that the recruitment can be adjusted to demands, and working conditions in different agencies equalized.

One could not help being struck by the emphasis placed by several speakers on the fact that the bulk of professional agricultural workers find employment in government agencies. Dr. Phillis pointed out that administrators have many other things to do with their limited funds than to devote them to agricultural research and extension work. Granted that our members must find employment in this way—even though private industry can be expected to absorb relatively more graduates in the future—some of us at least must accept almost inevitable disadvantages from a purely professional viewpoint of employment in the public service. These disadvantages do sometimes include the need to bury our own dead—offset to some extent by the unique privilege of being able to hide an occasional body or two when the post mortem would prove embarrassing; another disadvantage is the very real risk of loss of initiative and enthusiasm—against which must be matched the deep satisfactions which can arise from a task

well done in the public interest; and of course there are many offsetting advantages and no need for despair. This is not to deny Mr. Willoughby's contention—that in some cases the professional capacity of agricultural scientists is not fully utilized, and much can be done to improve this position. But some such wastage is almost inevitable in a public service whose primary responsibilty is to administer policy, not to conduct research. Another important factor in this respect is the maintenance of free opportunity for movement from one job to another, which enables a person to find the opportunity best suited to his capacity and his preferences.

The Chairman said that we all seem to be on common ground in accepting that the Institute should keep the contribution being made by its members to agricultural science in Australia under review, and should do more to draw these contributions to the attention of the public and of influential bodies. This would, in turn, lead to active efforts to widen the field of opportunities, especially in private industry, and in fields of work which are relatively unexplored in Australia such as the virtual no man's land between pure research and pure extension. There is surely some need, too, for constant re-appraisement of the changing demands for different specialists. Who, for example, can now say what the effects of the new work on radio-isotopes in agriculture will be on the relative scope for work between geneticists, entomologists, biochemists and other specialists? Is the intake of specialists into different fields to be planned, or allowed to work itself out by the effects of employment opportunities on the choices made by undergraduates of their fields of specialization? These problems merge into administrative responsibilities of government departments but the Institute surely has a role in maintaining them under constant review.

Another major responsibility for the Institute is to keep a sharp lookout for opportunities to assist in adjusting ourselves to changing conditions or new knowledge. The current emphasis on extension work, for example, has its roots in the past efforts of the Institute to stress the urgency of this field of work; the Institute has been active in publicising the importance of agricultural engineering as a specialized subject; and in the future similar opportunities may arise, and indeed they exist now in respect to the application of farm management research results in agricultural extension work.

In the future we can continue along these lines by pointing out to appropriate authorities the benefits which might arise from freer interchange of personnel even on a temporary basis.

In all such matters, of course, it would be naive to believe the Institute can do much without effective liaison and co-operation with the public authorities which are ultimately responsible for decision of this kind. In other instances, as Mr. Grogan has pointed out, our efforts can be exerted in a direction which supports the contentions being made by agricultural administrators in their dealing with other government authorities.

It would, of course, be a source of great satisfaction to the Institute if the endorsement of its work so far given in the form of monetary grants could be extended. This could take the form of a request from an appropriate authority to report to it annually on matters which require the unfettered and free analysis and expression of opinion which only the Institute can provide. Thus the Institute might be called upon to maintain under continuous review such matters as:—

(i) the demand and supply position for agricultural scientists in general and for each major field of specialization;
(ii) the factors which are contributing to the distribution of professional workers among different employment opportunities. For example, salary differentials, and also the distribution of resources between research and extension work;
(iii) the effects of these factors on the contributions being made by agricultural scientists to rural development.

Of course, these problems are not new, and the Institute may well give attention to them in any case. But an invitation from an appropriate body would enable the Institute's review to be used more effectively as a basis for the policy decisions which have to be made relating to the most effective use of our all too limited resources devoted to agricultural science.

Dr. Williams said that the Institute cannot help but gain from the free discussion we have had of its activities relating to recruitment and the importance of the work of agricultural scientists. The positive contribution of the discussion is the expressed agreement on the need for the Institute to re-appraise its work on recruitment, to keep itself fully informed on entries of students to Faculties and of employment opportunities; and to expand its publicity relating to the contributions of agricultural science to the nation's welfare.

In conclusion the Chairman thanked the members for attending and expressed his appreciation to the Standing Committee for honouring the Branch by their presence at the meeting.

### The Institute and Recruitment.

The Australian Institute of Agricultural Science first became interested in obtaining more agricultural scientists during 1951.

In that year the Victorian Branch became concerned that the post-war increases in the supply of graduates in agricultural science from the Rural Rehabilitation Scheme was nearing an end while it was obvious that the demand for men with this training was still high.

Information on the positions available, salaries, courses and scholarships in all States was assembled, and by March, 1952, a draft booklet, written for students at the Leaving Certificate level, was submitted to the Council of the Institute. Approval for its production was given and subsequently the President, Dr. A. R. Callaghan, obtained £500 from the Commonwealth Extension Services Grant to cover the cost.

This brochure "Careers in Agricultural Science" was distributed in Victoria and Queensland in late 1953 as the first action in what has become known as the "Recruitment Campaign". The N.S.W. and Sth. Aust. editions were distributed in early 1954. A separate booklet, "Make Agri-

cultural Science Your Career", was produced in 1955 for the special conditions in West. Australia with the assistance of a further £150 from the Commonwealth Extension Services Grant.

The distribution of the brochure has been reinforced by press articles, radio talks and addresses given in schools by members of the Institute. A careers article was also provided in a monthly magazine used by State Education Departments. A reprint of this article was supplied to every pupil in the Intermediate Certificate classes in Australia. Careers exhibits have been conducted in Sydney in 1955 and 1956, and in Melbourne in 1956, with the willing assistance of the State Departments of Agriculture.

The total cost of these activities has been approximately £2,350 which does not include the time spent by members of the Institute. The Institute's work has been the major factor in the doubling of total enrolments, from 130 in 1953 to 263 in 1956, in the first year of the agricultural science courses in Australian universities. The details of these enrolments are shown in the issues of this Journal for September, 1955, page 194, and September, 1956, page 223.

During the period 1953 to 1955, which is the latest date for which information is available, the total new enrolments of males only in Australian universities have risen 17%. In these three years the new enrolments of male students in the science faculties have risen 23%, in veterinary science 22%, in agricultural science 71%; while engineering has shown a fall of 4%.

The Council of the Institute is convinced that the recruitment of agricultural scientists is important for Australia's national development. The original brochure, of which stocks are now exhausted, is being reprinted and two posters to aid in its distribution have been published with the assistance of private industry. A series of articles on individual careers is being prepared, and the Institute is co-operating with the Standing Committee on Agriculture and the Victorian Department of Agriculture in the production of two films. The Institute is also co-operating with the Institution of Engineers Australia, and the Royal Australian Chemical Institute on the broader aspects of the recruitment of scientists.

*J. A. Roberts,*
*Executive Officer.*

## BOOK REVIEWS

### FARM ELECTRIFICATION HANDBOOK

(*The Electricity Supply Association of Australia*, 1956, £5/5/-)

This is a series of "notes" for the non-specialist: architect, extension officer, farmer. There is more of description than of numerical data; photos and sketches, but only one graph (an interesting one showing temperature versus time for slow and quick freezing).

It is done in elaborate looseleaf form, quarto size, with tabbed separators for 19 sections. Some sections are blank or incomplete; it is intended by the publishers (the Association) to issue additional, new or amended material from time to time.

The biggest sections are No. 4, the Farm Home, and No. 9, Water Supply and Irrigation. Lighting in the home is well illustrated and informative, and will help the reader understand what good lighting is and how to get it. There is a good general description of appliances for space heating, with an empirical rule for estimating the loading to be provided (Kilowatts) for background heating in typical rooms.

In Section 9, Water Supply, there are good descriptions and illustrations of pumps, a table of friction loss in pipes, but no characteristic curves of pump performance.

There are sections on motors and, surprisingly, wiring installations, as well as sections on the special agricultural industries such as dairy, poultry, horticulture.

The book will no doubt also be welcomed by appliance companies and salesmen: "With the introduction of electricity into rural areas and the advent of higher cost of fuel even for the country dwelling, a much wider field of development is assured for the electric hot water system".

Quite so; but efficiency of electrical energy installation and consumption is not raised as an economic or a technical problem. The fact is that most electricity systems in Australia are perpetually on the edge of their generating capacity. Before the war their problem was to persuade farmers to install and use electricity; now their problem is to meet the demand on their systems, and to persuade consumers and their advisers to use electricity efficiently—at times not at all!

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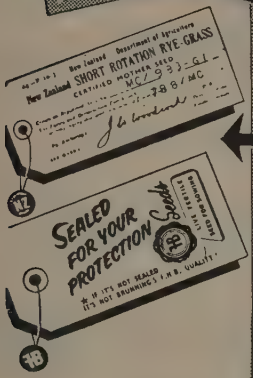


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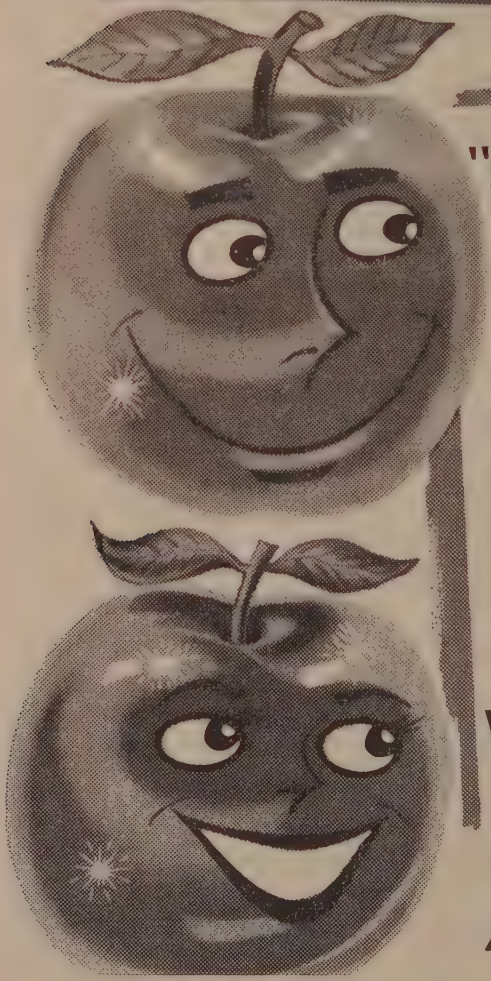

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# NEWS ITEMS

**Myxomatosis—Plans for this Season.**

A conference of Commonwealth and State authorities was held during September at the headquarters of C.S.I.R.O. (Melbourne) to plan the current season's myxomatosis campaign.

The conference included representatives of C.S.I.R.O., State Departments of Agriculture and of Lands, the Commonwealth Department of Commerce and Agriculture, the Graziers' Federal Council, the Australian Wool and Meat Producers' Federation, the Australian Primary Producers' Union, Commonwealth Serum Laboratories, the Walter and Eliza Hall Institute for Medical Research, and the Australian National University. Sir Ian Clunies Ross was Chairman.

The meeting discussed the field performance of the disease during the past year, the results of recent research and plans for future work.

*Low Rabbit Numbers.*

Present performance of the disease in the various States was reviewed. Widespread dispersal of myxomatosis occurred for the first time in Tasmania this season. This followed exceptionally wet weather.

Reports from all States indicate that rabbit populations are extremely low. Myxomatosis has been largely responsible for the reduction in rabbit numbers but other factors have also contributed. The widespread and organized use of the poison "1080" has been particularly important in Tasmania and Western Australia. Also, climatic conditions, especially the very heavy rainfall, have adversely affected rabbit breeding.

In Tasmania poisoning with "1080" has been most successful. Rabbit numbers have been reduced to an extent which compares favourably with results achieved by myxomatosis in the Eastern States.

*Weaker Virus Appearing.*

Professor F. Fenner of the Australian National University reported on his examination of over 150 strains of myxomatosis virus, including strains from Europe and America.

In Australia, strains of the virus with reduced virulence appeared in the field soon after the initial release of myxomatosis in 1950. These less virulent strains have become dominant.

In Europe the less virulent strains did not appear as rapidly but they are now the dominant strains there also.

*Inoculate with Standard Virus.*

The conference recommended that further large-scale inoculations with the standard (high virulence) strain of the virus should be carried out this season. This will help prolong the period of effective use of myxomatosis by allowing fewer rabbits to survive and breed.

If existing low virulent field strains are allowed to develop without some competition from the standard strain of the disease there will be a much bigger reservoir of survivors to provide genetically resistant progeny.

A high incidence of myxomatosis in the coming spring and summer is predicted. To take maximum advantage of these favourable conditions, a campaign for the general release of the standard (high virulence) strain of the virus was started in mid-October.

*"French" Virus Unsatisfactory.*

Experiments aimed at introducing the "French" strain of the virus indicated that it did not survive in competition with the existing dominant field strain of low virulence. A warning was given against further introduction of the "French" strain. It appears that this strain has given rise to much less virulent forms of the virus.

*Inheritance of Resistance.*

Experiments undertaken by Dr. I. D. Marshall of the Australian National University and Dr. W. R. Sobey of the C.S.I.R.O. Animal Genetics Section have confirmed that rabbits can inherit some degree of resistance to myxomatosis.

Observations in the field have indicated that rabbits are in fact inheriting resistance to the disease but further investigations will be necessary before the degree of this inheritance can be assessed.

*Insect Vectors.*

The C.S.I.R.O. Wildlife Survey Section reported the results of its studies on insects—primarily mosquitoes—which transmit myxomatosis.

A clearer understanding is being reached of the way in which the occurrence of rainfall at suitable periods to provide adequate breeding places affects insect numbers. This makes it possible to predict, for some areas which have been studied in detail, the optimum time for field inoculations.

*Rabbit Flea.*

The conference was told that it was believed that the European rabbit flea was a major factor in the spread of myxomatosis in the United Kingdom.

(The Australian Agricultural Council agreed at its meeting in July 1956 to a recommendation that the European rabbit flea be used for myxomatosis experiments in Australia.)

The conference agreed that such experiments would be valuable, subject to tests to confirm that the flea is harmless to Australian fauna. However, a final decision on the introduction of the flea (which is specific to the rabbit) is a matter for decision by the Commonwealth Department of Health.

**Arid Zone Research Conference.**

An international conference entitled "Australia—UNESCO Symposium on Arid Zone Climatology" was held at the University College, Canberra, from 17th October to the 20th October.

Overseas and Australian scientists engaged on desert research attended and discussions were held on current research and its application to the solution of problems in arid and semi-arid areas, as well as on plans for future research.

The Conference was opened by the Minister in Charge of C.S.I.R.O., Mr. R. G. Casey, and was addressed by Sir Ian Clunies Ross.

The opening address was given by Dr. C. W. Thornthwaite, of the Laboratory of Climatology, Drexel Institute, Elmer, U.S.A., who was chairman of the conference.

### Building Extensions—University of Queensland.

Plans for the new Biology building (University of Queensland) at St. Lucia have been completed, and are now in the hands of the architects for the supervision of building operations. The estimated cost of the building is £500,000 and construction work in the nature of excavations has been in progress for some time. The new building of brick and sandstone will house the departments of botany, zoology, entomology and agriculture. This building will be the biggest outside the main University building, and it will complete the semi-circle of University department blocks so far formed by the chemistry, geology and physics buildings: the total cost of works completed so far on the new University at St. Lucia is £2 million.

The Plant and Soils Laboratory, C.S.I.R.O., which is located in temporary buildings at George Street will eventually move to a new site, adjacent to the University of Queensland, at St. Lucia. The building, first proposed in 1940 and now to cost approximately £150,000, will accommodate about 70 and have laboratories, glasshouses, offices and storerooms for plant and soil research.

### Winter Wheat.

There is a definite need for new varieties of winter wheat better than those at present available. In New South Wales this year half the wheat crop in the north-western wheat belt could have been sown in March and April if a rust-resistant winter wheat of good baking quality had been available. The only wheat of winter habit grown in any quantity is Winter Minflor although it has the disadvantages of rust susceptibility, weak straw and inferior grain.

There is much interest in a new winter wheat hybrid bred by the N.S.W. Department of Agriculture and being tested in the north-west. If it proves to be of real commercial value it could lead to a very valuable expansion of winter wheat production.

### Rabbit Skins.

There has been a very big fall in the export of rabbit skins in recent years because myxomatosis has decimated rabbit populations in the eastern states. In 1950-51 13,699,000 lb. of skins were exported but in 1950-54 exports amounted to only 4,580,000 lb. It is expected that export of rabbit skins will continue to decline. Felt hat manufacturers in Australia are now looking for substitute materials to replace the once universal rabbit fur.

### N.S.W. Department of Agriculture.

A further step has been taken in decentralizing the Department's activities by creation of the new South-Western Agricultural Region which came into operation on 1st November. It includes the Murrumbidgee Irrigation Area and extends from Hillston to Corowa and westward to Balranald and also includes the Upper Murray Irrigation settlements. Twenty seven officers of the Department will operate in the new region.

### Sydney University Agricultural Graduates' Association.

S.U.A.G.A. is now more active and has a greater financial membership than for some time. The annual meeting was held on 5th September and was well attended. After the formal business, Mr. J. Potter, of the Agricultural Extension Services of the N.S.W. Department of Agriculture, gave an excellent illustrated address on "Agricultural Extension in Great Britain".

Miss Barbara Carne is editor of the Newsletter, which circulates news of graduates and the Agriculture School, and is greatly appreciated by S.U.A.G.A. members. Features of S.U.A.G.A.'s social activities each year are a cocktail party to welcome new graduates, a ball and a golf tournament. The Association is compiling a photographic history of the Faculty of Agriculture at Sydney and Miss A. Kingsland at the School of Agriculture, University of Sydney, would appreciate any additions to the collection.

### C.S.I.R.O. Research Results.

The following brief reports of recent research findings by workers in various divisions of C.S.I.R.O. were contained in the eighth annual report of the organisation for the year ended June 30th, 1955-6.

*Cobalt "Bullets" protect Sheep.*

A novel method of protecting sheep against Vitamin B12 deficiency and "phalaris staggers" has been developed by the C.S.I.R.O. Division of Biochemistry and General Nutrition.

"Bullets" made from a baked mixture of cobalt oxide and china clay are swallowed by the sheep and lodge in the rumen or the adjacent forestomach. They provide the sheep with an adequate supply of the essential element cobalt.

Cobalt deficiency in sheep occurs in various areas throughout Australia and has been shown by the Division to be responsible for such diseases as "phalaris staggers". This latter condition most commonly occurs in the autumn and winter months following the grazing of young phalaris shoots which emerge after autumn rains.

Frequent drenching with cobalt solutions is effective in combating "phalaris staggers" but is impracticable with large flocks. Top-dressing of

pastures with cobalt fertilizers is too expensive for large properties and, in any case, its effects may be short-lived. Salt licks are unreliable.

The heavy cobalt "bullets" appear to offer an effective answer to the problem. They are inexpensive and easy to administer. One dosing should protect for many months, probably for some years. Although the technique has only reached the trial stage, it seems likely that suitable "bullets" will be developed which will remain in the rumen for the whole life of the animal and will continue throughout to provide the very small amount of cobalt that is so essential.

The "bullets" are simple to manufacture. The clay and cobalt oxide mixture is mixed with water to a plastic state, extruded into a rod and cut as in brick-making, and finally baked at temperatures of up to 900° Centigrade. They are estimated to cost about one penny each.

The "bullets" are heavy enough to stay lodged in the fore-stomachs. The cobalt dissolves from them slowly but at a sufficient rate to provide enough cobalt to enable the growth of the micro-organisms which produce Vitamin B12.

*Simplified Process for preserving Building Timbers*

A simple and successful method for treating green sawn timber of scantling size to immunize it against insect attack has been developed by the C.S.I.R.O. Division of Forest Products.

The new process extends to sawn timber the Division's cold dip process originally developed for the treatment of green veneers.

The process has recently been applied without difficulty to the treatment of klinki pine for the construction of 50 houses in New Guinea.

For sawn timber, the present method of immunizing against Lyctus borer attack is to treat the green or semi-dry timber in a solution of boric acid or borax until the solution has completely penetrated all susceptible sapwood. Hot dipping can be used involving 24 hours for one treatment or the timber can be stepped in cold solutions for several days.

For green veneer the Division some time ago developed a simplified treatment in which a momentary dip in a cold solution of boric acid or borax is followed by block stacking of the wet sheets for a few hours to permit diffusion of the chemical into the wood before drying. This process is now used commercially in many Australian plywood plants.

The new process for cold dipping sawn timber does away with large and costly tanks and no steam is required. It also eliminates the need for frequent chemical analysis of the preservative solution which is essential in the present tank process.

The green timber is dipped momentarily into a solution containing a boron and a fluorine compound. Enough solution is retained on the surface to penetrate subsequently into the timber to a depth of at least half an inch. The wet timber is then block stacked for periods of several weeks to allow deep diffusion of the chemicals into the wood.

The timber is treated while completely green and penetration occurs into the heartwood as well as the sapwood. The normal dip solution provides protection against Lyctus or Anobium borers but other chemicals can be added to give protection against termites and other insects.

*Improved Carbonizing of Wool.*

Damage to wool in carbonizing (a treatment used to remove burrs and other vegetable matter from wool) can be avoided by a new process developed in the C.S.I.R.O. Wool Textile Research Laboratory, Melbourne.

The new process involves the addition of a wetting agent to the sulphuric acid bath used in carbonizing. Wool containing large amounts of burr is treated with acid to remove this contaminating material. Unfortunately although the acid destroys the grass seed it also attacks the wool fibres to some extent at the same time.

The Laboratory has found that all types of wetting agent offer some protection to the wool and that the amount of wetting agent required depends on the efficiency of the scouring.

The most satisfactory material tested has been a non-ionic wetting agent, Lissapol NX, and with an efficient scour 0.03% added to the acid bath is sufficient. Additions of 1 lb. of Lissapol NX for each 200 lb. of greasy wool would be usual.

The presence of burr in Australian wools has always been a problem to the textile manufacturer. With the increasing adoption of pasture improvement, burr is collecting in fleeces in more serious quantities.

*Better Vaccines.*

Longer effective life for vaccines, cheese starter cultures, inoculums for clover seeds, and other preparations of micro-organisms will result from the use of a new technique developed by the C.S.I.R.O. Division of Food Preservation and Transport.

The technique stabilizes preparations of micro-organisms which are freeze-dried.

Freeze-drying is now the principal method used in Australia and overseas for the preservation of micro-organisms on an industrial scale. Some micro-organisms dried in this way will, even after prolonged storage in the dry state, begin to grow again when placed in a suitable moist environment. Others, however, fail to survive for reasons which have not previously been understood.

The Division has shown that death in the dry state is due to a chemical reaction of the kind which produce one type of brown colouration often seen in cut fruit. It has found a way of preventing this reaction. This enables the successful preservation of many organisms which previously succumbed under freeze-drying.

The process is now being used commercially in Australia for several veterinary vaccines. The new products will be a little more expensive, but this will be more than off-set by the increased stability and longer shelf life of the cultures.

The process will find application in preserving yeasts, viruses and some living vaccines used in human and veterinary medicine, root nodule bacteria used to inoculate clover seed, cheese starters, and many other materials which cannot otherwise be successfully stabilized and which rapidly lose their potency. Stabilization of these products will enable quantities to be stored against an emergency and will greatly facilitate distribution to remote areas.

### Olympic—A New and Better Wheat

Another new and improved wheat variety, Olympic, has been produced by research officers of the Victorian Department of Agriculture. Seed of the new variety will be available to growers after next harvest.

The evolution of Olympic was a result of the combined efforts over many years of Departmental geneticists, agronomists and cereal chemists. Its sowing on an extensive area in the Victorian wheat belt is expected to increase a normal harvest by at least two million bushels, valued at more than £1,000,000 per annum. Olympic also produces grain and flour of better quality than varieties now grown commercially in Victoria, and this asset will be a distinct advantage to both the export and local trades. Consumers also should benefit by an improvement in bread quality.

Reporting on the new wheat, the Agricultural Superintendent of the Department, Mr. W. B. Miller, said that the creation of Olympic marks a major advance in the Department's long-term programme to improve both the yield per acre and the quality of Victorian wheat. In this work, hundreds of crosses between promising parents are carried out, and thousands of selections are made from the progeny in an endeavour to combine desirable characteristics and obtain even one outstanding new variety.

The parents of Olympic were the well-known varieties Baldmin and Quadrat, and the originating cross was made in 1937 at the State Research Farm, Werribee, by Mr. A. R. Raw, Senior Geneticist of the Department. In 1939, the second generation crossbred material was transferred to the wheat breeding nursery at Longerenong Agricultural College in the Wimmera, where further selections for the desired type were made, and grain samples taken for quality tests.

After further trials at Longerenong, extending over 6 years, the most promising selections were then compared with standard and other varieties in twenty districts of the State. Olympic emerged successfully from all these tests.

In replicated trials throughout Victoria during the past six years, Olympic has outyielded Quadrat by 4.5 bushels per acre (average of 89 tests) and Pinnacle by 4.0 bushels per acre (average of 64 tests). It is being recommended to replace both these varieties in all districts.

In Mallee tests during the past five years, there has been little to choose between Olympic and the earlier maturing Insignia, and more tests, including some in drier years will be made.

Olympic is a mid-season wheat maturing slightly earlier than Quadrat and Pinnacle, but later than Insignia. It produces cream-coloured ears on a fine medium-height straw.

### Visiting Scientists

Dr. M. S. Thacker, Director of the Indian Council for Scientific and Industrial Research, visited Australia during October at the invitation of C.S.I.R.O.

Dr. Thacker examined scientific developments in this country and conferred with C.S.I.R.O. and University scientists.

Dr. Thacker is the author of many scientific papers on power technology and high voltage engineering. He has represented India at a number of International Conferences and Committees, and led the Indian delegation to the World Power Conference at Rio de Janiero in 1954. He is a Fellow of the American Institute of Electrical Engineers.

In 1955, the President of India conferred on him the award of Padma Bhushan.

A number of overseas Agricultural Scientists visited various centres in Australia while en route to the International Grasslands Congress which was held in New Zealand in November.

Among these were Dr. R. O. Whyte, who is attached to F.A.O. in Rome, Mr. A. Laird Rains, an agronomist attached to the Agricultural Department in Nigeria, and Mr. George Cripps, Manager of Agricultural Development, Climax Molybdenum Co., New York.

Dr. E. Erikson, of the International Institute of Meteorology, Stockholm, visited Victoria after the Arid Zone Symposium, which was held in Canberra during October.

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# PERSONAL NOTES

Professor L. J. H. Teakle from Brisbane visited Canberra in mid-August to attend a forestry conference. He spent some time in the field with soils people and was interested to see age-sequences of soils on the river terraces and in the layers of hill-wash on the hill slopes.

Mr. N. Wells of the Soils Bureau, D.S.I.R., New Zealand visited Canberra in mid-August for a few days. His work has been in assaying the fertility of soils by the growth of sweet vernal. He was interested in seeing age sequences of soils at Canberra because his work has shown a variation in the fertility of elements related to the degree of weathering of soils in New Zealand.

### New South Wales.

*Mr. R. Marquez* has been awarded the degree of M.Sc.Agr. from the University of Sydney and following his two years post-graduate research in Microbiology has returned to the Philippines.

*Dr. D. A. Lewis* recently returned from the U.S.A. where he was awarded the degree of Ph.D. from the University of California for his work in the field of vegetable physiology.

*Dr. S. Smith White* has been awarded the degree of D.Sc.Agr. from the University of Sydney for a thesis entitled "Cytogenetic Studies of the Australian Flora".

*Dr. B. Z. Breyer,* who for some time has been on the staff of the Agricultural School at Sydney, has been appointed Associate Professor of Agricultural Chemistry. This recognition of Dr. Breyer's excellent teaching and research work will be widely welcomed.

*Dr. N. Collis George* of Cambridge has been appointed Associate Professor of Soil Science in the Agriculture School at Sydney and commenced duties in November.

*Miss J. Whitehouse,* who was Teaching Fellow in Plant Pathology, Genetics and Plant Breeding at the University of Sydney has been appointed Lecturer in Mycology at the New England University.

*Mr. N. H. Luig* has been appointed Research Agronomist in the N.S.W. Department of Agriculture and is working at Sydney University as a member of Professor Watson's team of cereal breeders.

Latest appointments as Special Agronomists in the N.S.W. Department of Agriculture are *Mr. K. R. Green* as Special Agronomist (Weeds) and *Mr. E. J. Waring* as Special Agronomist (Miscellaneous Crops).

### Queensland.

*Mr. John McPaul,* formerly Soils Technologist with the Department of Agriculture and Stock, has joined the Overseas Civil Service and is at present stationed at the Department of Agriculture, Suva, Fiji, as Soils Chemist.

*Professor D. A. Herbert,* University of Queensland, is away on study leave visiting various University botanical centres, agrostological and horticultural research stations. Professor Herbert sailed from here in early January and called at South Africa on the way, arriving in England in March. Two continental tours have taken him through Germany and Italy and Norway, Sweden and Holland. He is at present in England representing Australia at the British Association for the Advancement of Science Meeting at Sheffield.

Professor Herbert is due back in January next year, but before then he proposes to visit Scotland and Wales.

*Mr. E. Jones,* who was handling the sorghum breeding programme at Biloela, has resigned from the Department of Agriculture and Stock to take up a teaching position at the rural high school—All Saints College, Bathurst.

*Mr. G. I. Alexander,* Senior Husbandry Officer, Department of Agriculture and Stock, has been awarded an assistantship in the Department of Animal Husbandry at Oregon State College, U.S.A., for a period of eighteen months.

*Mr. N. Wells* of the D.S.I.R. Soil Bureau, Wellington, New Zealand, recently made a private visit to Brisbane and spent some time in discussion with *Mr. G. D. Hubble* and other soil scientists. Mr. Wells is known chiefly for his work on the spectrographic examination of soils and plant materal. In particular he has studied the use of sweet vernal, (*Anthoxanthum odoratum*), as an indicator of nutrient availability, instead of soil extraction methods. His recent papers have dealt with the mineral composition of sweet vernal in relation to the stage of growth of the plant and the soil type on which it is grown. He has also investigated the fixation of molybdate ion in New Zealand soils.

*Dr. R. B. Das* from the Desert Afforestation Research Station at Jodhpur in the north-west of India, paid a week's visit to Brisbane during October. The research team to which Dr. Das belongs was originally appointed to study the use of forest belts for desert reclamation, but the spectacular success of experiments on the reseeding of native grasses led to a change of objective in favour of pasture research. In an area with high temperatures and a relatively low rainfall restricted to a short period of the year, Dr. Das and his co-workers are confronted with problems similar to those found in Queensland. Lack of nitrogen seriously limits pasture production and the introduction of suitable legumes is proposed, but some concern is felt

with regard to the quantities of nitrogen which could be fixed during the short growing season at Jodhpur.

*Dr. Albert Ulrich* of the Department of Soils and Plant Nutrition at the University of California visited Brisbane during late November following the Grassland Congress in New Zealand. He delivered an informal talk, "Plant analysis as a guide to the mineral nutrition of crops", to members of the agricultural fraternity, using lucerne and sugar beet results as illustrative material.

**Victoria.**

*Dr. H. C. Forster*, returned to Australia during September preparatory to accepting his new appointment as Professor of Agriculture at Melbourne University. Dr. Forster had spent several months visiting agricultural centres in the United States and Europe.

*Mr. F. M. Read*, formerly Superintendent of Horticulture in the Department of Agriculture, has been appointed to the position of Deputy Director.

*Mr. B. F. McKeon* has been appointed Senior Technical Executive Officer in the Department of Agriculture.

*Mr. F. S. Crawford* of the Weekly Times left for a visit to the U.S.A. during October.

*Mr. C. J. Johnston*, Entomologist of the Department of Agriculture, and *Dr. L. H. P. Jones* of C.S.I.R.O. also left for visits to the U.S.A.

*Mr. A. A. Lee* of British Farm Equipment recently returned from a trip to the U.S.A. and England.

*Mr. L. Stubbs* recently returned from the U.S.A. where he spent 18 months working on viruses at the Californian Institute of Technology.

*Mr. R. J. Newman*, Agrostologist of the Department of Agriculture attended the International Grasslands Congress held in New Zealand from 7th-16th November. *Mr. W. B. Mackie* of Commonwealth Fertilisers and *Mr. J. Fisher Pollard* of Potash Australasia Ltd. also attended the Congress.

**Western Australia.**

*Mr. J. Lawson* was in Perth recently over the Royal Show period. He has been engaged on a considerable amount of experimental work at Carnarvon where he is stationed with the North West Branch.

*Mr. H. Suijdendorp* of the North West Branch attended the Arid Zone Symposium at Canberra in October. The Symposium was conducted by U.N.E.S.C.O. and is held in various countries throughout the world.

*Mr. B. Truscott*, a graduate of the W.A. University, and formerly of the Victorian Department of Agriculture, has returned to a position with Cumming Smith & Mt. Lyell. Our congratulations to him on his forthcoming marriage.

*Mr. C. M. Ralph*, who is stationed at the Salmon Gums Research Station, is expected to be going farming in the near future. He has recently obtained a block at Esperance Downs.

New graduates who have joined the Department of Agriculture are *Miss C. Pilter* and *Mr. K. Richards*. Both are in the Entomology Branch.

*Mr. M. Hawson*, now in Malaya and *Mr. K. Cole*, now in Papua, are hoping to revisit the State shortly. Mr. Cole is expected to be on leave in December.

## BRANCH NOTES

**New South Wales.**

At a well attended meeting on 25th September, Mr. Selwyn Speight of the Editorial Staff of the Sydney Morning Herald, gave a very interesting address on "The Changing Pattern of Chinese Agriculture" and discussed many points of interest raised by the audience.

Mr. Speight recently visited China and travelled widely in that country. His "Report on China", published as a series of articles in the Herald aroused a great deal of interest for its informative and challenging picture of progress in modern China.

A special combined meeting was held on 5th October in conjunction with the N.S.W. Branch of the Australian Society of Animal Production. Dr. C. P. McMeekin, of the Animal Research Station, Ruakura, New Zealand spoke very entertainingly about "Recent Research at Ruakura".

At the ordinary general meeting on 25th October, Dr. I. A. Watson, Associate Professor of Genetics and Plant Breeding, University of Sydney, spoke about some aspects of his recent overseas trip and his current work in Sydney under the title "Recent Developments in Cereal Breeding". Dr. H. K. Pratt, a Fulbright Fellow from the University of California at Davis, who is at present working in the Plant Physiology Unit of the Division of Food Preservation and Transport of the C.S.I.R.O. in Sydney, addressed the meeting on "Transportation and Storage of Fruits and Vegetables". Dr. Pratt's own special field is the post-harvest physiology of vegetables.

**Queensland.**

At the 132nd Ordinary General Meeting of the Branch, held on 25th July, our President, *Professor L. J. H. Teakle*, welcomed the Executive officer, *Mr. J. A. Roberts*, who addressed

the meeting on the proposed purchase of the Australian Wool Bureau building. The main business of the meeting was given over to notes and exhibits. *Mr. V. R. Catchpoole,* Honours student in the Faculty of Agriculture, University of Queensland, spoke on "Some chemical properties of the Mitchell grass downs soils at Muttaburra". *Mr. G. D. Bowen,* Plant Pathologist with the Department of Agriculture and Stock, discussed "Symbiosis of subtropical and tropical legumes". *Mr. J. G. Morris,* Husbandry Officer with the Department of Agriculture and Stock, addressed the meeting on "Drought feeding of cattle". In addition, *Dr. L. G. Miles* showed a slide demonstrating *Phytophthora* stem rot resistance in cowpeas, and *Mr. P. J. Skerman* showed slides illustrating aspects of soil fertility investigation on the mulga country of Western Queensland.

The 133rd Ordinary General Meeting, which was held on 22nd August in the Shell Theatrette, by courtesy of Shell Chemical (Aust.) Pty. Ltd., was well attended by Branch members and invited persons. *Mr. S. O. Cowlishaw,* General President of the Queensland Grain Growers' Association and *Mr. W. J. Cartmill,* Chief Soil Conservationist with the Department of Agriculture and Stock discussed the "Conservation of Soil and Soil Fertility".

### Victoria.

The Annual Dinner was held at the Union House, Melbourne University on 25th September and once more proved to be a highly enjoyable function for the hundred and ten members and guests who were present.

The distinguished list of speakers comprised, Prof. Sir Samuel Wadham, Sir John Medley, Mr. O. R. Mackinnon, Mr. N. A. Needham, Mr. A. W. Hamer and two representatives of the visiting Indian farmers.

On 19th October, forty members attended a special general meeting called to discuss three important subjects. These were (a) the use of the letters M.A.I.A.S. by members of the Institute who have been graduates for a certain period of time—of the order of five years—and who have been actively engaged in agricultural science for that period.

(b) A report on the survey of conditions of working of Agricultural scientists carried out recently by the Victorian branch.

(c) The recruitment and training of agricultural scientists. A number of propositions were put forward for discussion.

It was decided that a deputation should approach the Premier on the subject of salaries and status in an endeavour to obtain improvements desired by the branch.

On 29th October a meeting was addressed by Dr. E. Erikson, of the International Institute of Meteorology, Stockholm who was in Melbourne following the Arid Zone Conference. Dr. Erikson spoke on various phases of his own research at the Institute.

### Western Australia.

For its last two meetings the W.A. Branch has enjoyed papers presented by local scientists. On July 20th four papers were presented, namely by Mr. N. S. Halse—"Some Factors affecting the Chlorate Content of W.A. Tobacco Leaf"; Mr. E. N. Fitzpatrick—"The Effects of Lime on the Establishment and Growth of Subterranean Clover on an Acid Peaty Sand"; Mr. J. A. Carpenter—"Induction of Mutations in Subterranean Clover by X-rays"; and Mr. R. Mauldon—"Some Results of a Study in the Economic Efficiency of Farms in the Whole Milk Region of W.A." The varied programme as presented was much enjoyed by the members present.

At the last meeting on August 31st, a very interesting paper was presented by Mr. F. L. Shier, Superintendent of Wheat Farming in the W.A. Department of Agriculture. Mr. Shier spoke about "Agriculture and its problems in the Near East". Mr. Shier, who had spent more than a year on F.A.O. duties in this region, particularly Syria, supplemented his talk with a series of excellent Kodachrome slides, which were of great interest to all present.

On Thursday, October 11th a social was held at Shell House by the Institute for all members and friends. A buffet tea was served and several short films were presented by courtesy of the Shell Company.

## LETTERS TO THE EDITOR

Sir,

I have studied the circular about the proposed purchase of the building at 226 Clarendon Street, and have reached the following conclusions:

If the assumptions on which the President's arithmetic are based are sound then I, as a private member of the A.I.A.S., may not have to pay any money in addition to my subscriptions, in order to meet either the interest bill on the debentures or the repayment of the debentures in 10 years' time.

On the other hand, if the estimated rental of £1,000 a year is not realised, or the value of the building falls below its present highly inflated level, or the A.I.A.S. ceases to prosper, then I, as a private member, may have to take my share of responsibility for the debts of the

Institute. If, in the meantime, the number of members in the Institute becomes fewer, as I fear it may unless management is improved, then my share may be substantial.

In view of these risks I have decided that I shall resign from the Institute if and when the building is purchased.

This would be a personal matter and in no need of publication if it were not that I took a rather public part in opposing the Central Secretariat. I am still opposed to the Central Secretariat, but I have remained a member of the Institute despite the increase in fees caused by the Central Secretariat. I would therefore be grateful if you would publish this letter in your Journal so that my friends and colleagues in the Institute may know that my decision to resign stems not from prejudice or dislike of the Central Secretariat, but from fear for my pocket based on lack of faith in the financial wisdom of our Council.

H. G. ANDREWARTHA.

Zoology Department,
University of Adelaide,
August 17, 1956.

Sir,

Dr. Andrewartha, in his letter of August 17th, 1956 has expressed his opinion concerning the proposals for purchasing the Central Office building at 226 Clarendon Street, East Melbourne.

The facts are these. The financial proposals made by the President to members when asking for contributions to debentures to enable purchase of the building were based on the best possible advice from our auditors; from established agents specialising in city values, and from bankers. The method of finance by raising the money from members by debentures was advised by the Institute's auditors after a consideration of values of the building and probable rentals estimated by real estate valuers. Intending debenture holders need have no fear for their money. Their security is the land and building which is so situated that its value must increase rather than diminish. In fact, as Dr. Andrewartha expresses it in the second paragraph of his letter, a reasonable expectation is that it won't cost him anything more than his annual subscription. But Dr. Andrewartha puts forward some other pessimistic alternatives presumably in the hope of persuading other members either to resign, as he intends to do, or at least not contribute to the building fund.

Dr. Andrewartha need have no fear of being personally encumbered with a great debt. His only financial responsibility to the Institute, as he should know, is laid down in the Memorandum of Association, and amounts to . . . "a sum not exceeding five shillings for each year during which the corporate member is a corporate member of the Institute but not exceeding a total of £1 . . ." if the Institute ever reaches the unlikely state where its affairs need to be wound up.

Dr. Andrewartha's accusations of Council's mismanagement and lack of financial wisdom can only be proved wrong by the course of time. Council has acted in good faith, and in the light of all the facts, and opinions it could muster. Council stands by its judgment on this matter.

R. G. DOWNES.

Hon. General Secretary,
Aust. Inst. of Agricultural Science,
226 Clarendon Street,
East Melbourne, C.2,
October 29, 1956.

## ERRATUM

*The following correction is made to the paper "The Influence of Fungicides and Fruit Maturity on the Development of Ripe Spot and Target Rot of Apples", by G. C. Wade and J. R. Ward, which was published in the September,* 1956, *issue, Vol.* 22, *No.* 3, *page* 198.

*In Table II the heading of the second column should have read:—*

"Calyx and 1st cover (colloidal sulphur used for later covers in all treatments)."

## BOOK LIST

*Notice has been received that the following books on agricultural topics have been published recently.*

ANDERSON, Harry Warren. Diseases of Fruit Crops. *N.Y., McGraw-Hill Book Co. Inc.*, 1956. 91/-.

ANNUAL REVIEW OF PLANT PHYSIOLOGY. V.7, 1956. *Stamford (Calif.) Annual Reviews Inc.*, 1956.

ASHTON, E. D. Milk and Butter fat Recording. (Commonwealth Bureau of Dairy Science Technology Communication No. 3). *Farnham Royal, Commonwealth Agricultural Bureax*, 1956. 30/- stg.

CRAMPTON, E. W. Applied Animal Nutrition. *San Francisco, W. H. Freeman & Co.*, 1956. $6.50.

DEMOLON, A. Croissance des Végétaux Cultives. *Paris, Dunod*, 1956. 4.600F.

FOOD AND AGRICULTURE ORGANISATION OF U.N. Yearbook of food and agricultural statistics. Production Part 1, V.9, 1955. $8.50 or 17/6d. stg.

GREGORY, J. N. Radio-isotopes in industry and research (pp. 24). *Sydney, Aust. Atomic Energy Commission*, 1956. Not priced.

MAYNARD, Leonard, A. and Loosli, John K. Animal Nutrition, 4th ed. *N.Y., McGraw-Hill Book Co. Inc.*, 1956. $7.50.

O'LOGHLAN, Frank (ed.). Beef Cattle in Australia. *Sydney, F. H. Johnson Publishing Co.*, 1956. £2.

UNDERWOOD, E. J. Trace Elements in Human and Animal Nutrition. *New York, Academic Press Inc.*, 1956. £6/5/3.

## BOOK REVIEWS

### MANUAL OF ELECTRIC PUMPING

(*State Electricity Commission, Melbourne, 6th printing*, 1955.)

This slim volume of 112 pages offers a good and readable account of electric pumping for the nearly non-technical reader; it is thus well suited to the farmer or his adviser.

Half the book is devoted to a description of the pumps and their working, and to the kinds of service for which they are suited. It was good to see there the characteristic curves (head, power, and efficiency vs. discharge, at constant speed) of typical centrifugal pumps, and for the axial-flow pump. The axial-flow pump is becoming a live issue for drainage, irrigation and water storage.

Nevertheless the problem of matching the pump to the head-flow requirements of the job presents the usual difficulties for all but the reciprocating pumps—whose discharge is constant irrespective of head. These difficulties for the variable head-flow pumps are not clearly resolved in this booklet: "from reference to catalogue data published by a leading manufacturer it is found . . ."

Since pump makers keep their characteristic curves secret, they attempt to show the performance of these centrifugal pumps in a large double or triple entry table. The "Manual" would have done well to reproduce such a page of tables, and show how to use it.

The Manual contains clear and useful advice on pump mounting, and belt drivers, and some simple tables of hydraulic data. It was odd to see tables for pipe friction in cast iron pipes, showing pipe diameters down to ½ inch—in cast iron!

G. H. VASEY.

**Pink-eye in cattle is a distressing and dangerous disease**

# *Better a black eye than a pink one!*

If you're unlucky enough to acquire a "black-eye," you may be thankful that it isn't a "pink" one.

"Pink-eye" is a much more distressing and disfiguring complaint. It is confined to cattle and sheep.

They acquire it bacterially, not physically, and it is spread about when an animal sneezes or snorts

Cattle affected with "Pink-eye" (ophthalmia) lose condition rapidly. Milk production falls off, and temporary blindness caused through the infection can lead to serious injury or death by accident.

**Treatment now simplified.** Recent research at the C.S.I.R.O. McMaster Animal Health Laboratory, N.S.W., has found that "Pink-eye" in cattle can now be effectively treated through the application of Chloromycetin ointment.

Choloromycetin ointment is being made in Australia with the help of oil-based solvents. SHELL refineries are supplying the solvents necessary for the manufacture of this important anti-biotic. This is another instance where Shell are helping the Australian cattle-breeder and dairy-farmer to maintain healthier herds.

# EXTENSION OFFICERS

*New Plant Protection Products as a result of research by Australian Departments of Agriculture, C.S.I.R.O. and I.C.I.A.N.Z.*

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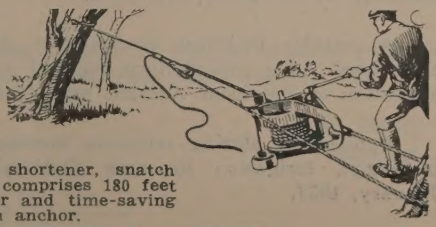

In the "Monkey" Grubber way clearing work is done expeditiously and without great outlay, leaving land ready for mechanical tilling. The machine delivers 260 times the power applied to the handle. It is portable and fitted with an automatic lowering gear, second speed, rope shortener, snatch block, etc. Cable equipment is generous and comprises 180 feet in four lengths each fitted with special labour and time-saving couplings. Takes an acre and a half from an anchor.

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## COMMONWEALTH OF AUSTRALIA

## COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

### Officer-in-Charge, Irrigation Research Station, Griffith, N.S.W.

The Executive of C.S.I.R.O. is inviting applications for appointment as Officer-in-Charge of the Organization's Irrigation Research Station at Griffith, N.S.W.

Work at the Station is concerned chiefly with investigations into the many phases of horticultural and agricultural productions under irrigation in the Murrumbidgee Irrigation Area of New South Wales. The fields of research include soils, hydrology, plant physiology and plant nutrition. Research workers on related problems from the Division of Plant Industry, and Soils, and the Wildlife Survey Section are also located at the Station. The home station has well-appointed laboratories and glass houses, and has an out-station devoted to a comprehensive long-term citrus experiment.

The Murrumbidgee Irrigation Area produces a wide variety of fruits and vegetables, rice, wheat and animal products. Canneries, wineries and rice-mills are established in the district, and extensive new areas will be developed for irrigation in the vicinity.

The Executive hopes to appoint a scientist with considerable research experience in one or more of the fields of work included in the Station's activities. Preference will be given to those currently engaged in research and with experience in the leading of a research team. The appointee will be responsible to the Senior Officer-in-Charge, Irrigation Research Stations, for general supervision and direction of the officers of the Station. He will have considerable freedom as to personal research in his own field.

**Salary:** Dependent on qualifications and experience, commencing salary will be within the range of Principal Research Officer, £2,517-£2,957 p.a., or Senior Principal Research Officer, £3,067-£3,524 p.a.

A suitable residence is available on the Station. The appointment will be conditional on a satisfactory medical examination. The position carries Superannuation or Provident Account privileges.

Application, stating reference number 500/81, should reach the Senior Officer-in-Charge, Irrigation Research Stations, C.S.I.R.O., Merbein, Victoria, by 31st January, 1957.

# APPOINTMENTS AVAILABLE

## THE UNIVERSITY OF NEW ENGLAND

### FACULTY OF RURAL SCIENCE

Applications are invited for the position of Research Fellow or Senior Research Fellow in Dairy Science.

The successful applicant will be expected to carry out fundamental research on the problem of depressed butter fat percentage in cattle on certain diets. Salary will be fixed according to qualifications within the limits £A1,100-£A1,500 for Research Fellows and £A1,600-£A2,000 for Senior Research Fellows, plus cost of living allowance of, at present, £A81 p.a. (males) and £A61 p.a. (females). The appointment will be for three years in the first instance, and may be extended to five years.

Further information and the conditions of appointment may be obtained from the undersigned with whom applications will close on 7th January, 1957.

W. M. ROBB,
Registrar.

Armidale, N.S.W.,
Australia.

## THE UNIVERSITY OF NEW ENGLAND

### FACULTY OF RURAL SCIENCE

Applications are invited for the position of Research Fellow or Senior Research Fellow in Poultry Science. The successful applicant will be responsible for the conducting of poultry research and specialist lectures in poultry science in the University. Adequate field and laboratory facilities will be available. Salary will be fixed according to qualifications within the limits £A1,100-£A1,500 for Research Fellows and £A1,600-£A2,000 for Senior Research Fellows, plus cost of living allowance of, at present, £A81 p.a. (males) and £A61 p.a. (females). The appointment will be for three years in the first instance, and may be extended to five years.

Further information and the conditions of appointment may be obtained from the undersigned with whom applications will close on 7th January, 1957.

W. M. ROBB,
Registrar.

Armidale, N.S.W.,
Australia.

## THE UNIVERSITY OF NEW ENGLAND

### FACULTY OF RURAL SCIENCE

### ASSOCIATE PROFESSOR OF LIVESTOCK HUSBANDRY

Applications are invited for the position of Associate Professor of Livestock Husbandry.

The appointee will be responsible for teaching in livestock husbandry, and will be expected to carry out research.

The salary will be £2,350 per annum plus cost of living allowance, at present £A81 per annum.

Conditions of appointment and additional information may be obtained from the undersigned with whom applications (two copies) will close on 4th January, 1957.

W. M. ROBB,
Registrar.

Armidale, N.S.W.
Australia.

DU PONT

# AGRICULTURAL CHEMICALS

*Du Pont agricultural chemicals, produced by the Grasselli Department of Messrs. E. I. Du Pont de Nemours & Co. of Wilmington, Delaware, U.S.A., are now available in Australia for use in agricultural, horticultural and pastoral industries. The following products constitute the current range:*

**MANZATE.** Manzate is a fungicide based on the chemical Manganese ethylene bisdithiocarbamate. This material has been specially developed for control of fungus diseases in potatoes and tomatoes and in fruit and vegetable crops.

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**FERMATE.** This is a fungicide based on Ferric dimethyldithiocarbamate. This material is particularly useful for control of tobacco fungus diseases.

**METHOXYCHLOR INSECTICIDES.** A number of formulations, based on Methoxychlor, are now available. These include Marlate 50, a 50% wettable powder for use on fruit and vegetables, and Marlate 2-MR, an emulsifiable oil, and Dairy Cattle Spray. These last mentioned sprays are for use wherever stock are handled.

**C.M.U. WEED KILLER.** This material is based on 3-(p-chlorophenyl)-1, 1-dimethylurea. It is a non-poisonous total weed killer, which is effective for long periods. At very low dilution it is ideal for pre-emergence control of weeds in crops as divergent as sugar cane and asparagus.

**AMMATE WEED AND BRUSH KILLER.** This material is based on Ammonium sulfamate and it is ideal for control of eucalypt suckers and other tree species. It will control Mallee shoots, Crofton weed and most perennial weeds and brush.

**Further information is readily available upon request.**

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